First Aid

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Introduction

The term first aid was probably first used by the Prussian military surgeon Johannes Friedrich August von Esmarch (1823 – 1908), who taught soldiers to apply bandages and splints to their injured comrades in arms.

There are three key points that define the ethos of First Aid:

- Preservation of life: the overriding aim of all medical care, including first aid, is to save lives and minimise the threat of death.
- Prevention of further harm: synonymous with the legends: “to prevent the condition from worsening”, or “to prevent danger of further injury”; this concept refers to both external factors (moving a patient out of harm’s way) and application of first aid techniques (ei. applying pressure to negate a bleed).
- Promotion of recovery: First Aid is the often only the first step in the transition of a pa-tient from being injured to being healthy, however it is often on of the most important steps, and sometimes can be the only step (for instance the application of a plaster to a small laceration).

“*First aid* applies to a broad range of medical situations. First aid is not just a set of skills. It also involves the ability to determine the appropriate response to a specific illness or injury. In some cases, the appropriate first aid measure is enough in and of itself – for example, putting a Band-Aid on a cut or ice on a superficial burn. This type of first aid can be described as self-sufficient. There is also a broad category in which first aid literally means providing the "first" aid – initiating a procedure such as *CPR* (cardiopulmonary resuscitation) or *defibrillation* for a *heart attack* – which will then taken over by medical professionals as soon as they become available. This is classic first aid. But in other cases, appropriate first aid means that all one can do is to get expert medical aid for the patient as quickly as possible. This type of first aid is the invaluable act of summoning urgent medical assistance.”

(source *http://www.medicinenet.com/script/main/art.asp?articlekey=52749*).

The basic knowledge and skills should be learned by each person in society, and this training should start from childhood to avoid unnecessary deaths.

(see also *http://www.novinky.cz/koktejl/313461-rodice-naucte-se-prvni-pomoc-hlasa-drsna-reklama.html*, *http://www.novinky.cz/koktejl/284373-reklama-s-muzem-ktery-se-udusi-soustem-je-prilis-drsna-stezuji-si-divaci.html*)

Jiří Málek

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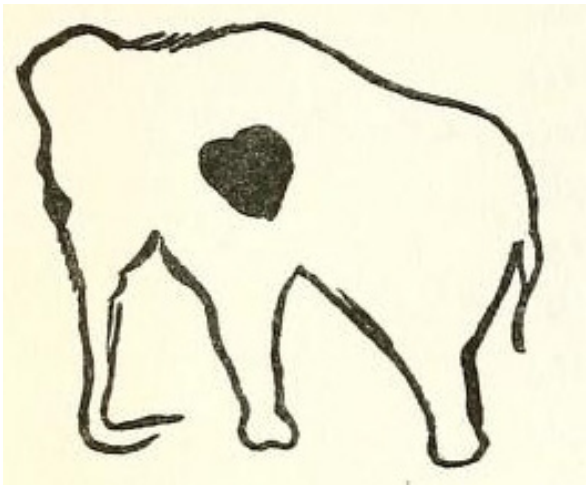
1. History of First Aid

The History of first aid probably starts in the Dark Ages. Palaeolithic pictures in a Spanish cave called El Pindal are believed to depict some knowledge of the heart being the source of life.



Picture 1: Palaeolithic pictures in a Spanish cave

Although we have relatively little information about prehistoric man, it is fair to say that they must have been confronted by relentless situations requiring First Aid – take for example, bleeding, broken bones and poisoning. All of these must have been extremely common in a hunter gatherer society. As of which, they must have developed ways to stop bleeding, to stabilise broken bones or to determine whether a particular plant was poisonous or not. Over time, we can assume that certain individuals would have become skilled in these fields, and may have become the first shamans and witchdoctors. This may also have been the first step in distinguishing between medical care which could be provided by the common man, versus the "professional." As medical training became more formalised (mirroring society as a whole) this distinction widened, and by 4000BC (Ancient Egypt) the idea of a physician and a surgeon had been developed. Priests became physicians and barbers became the surgeons. Hieroglyphs found in Ancient Egypt appear to show the goddess Isis using some form of mouth to mouth resuscitation on her husband, the god Osiris. (For resuscitation history see *http://www.lf3.cuni.cz/en/resuscitation/*)

The bandaging of battle wounds is known to have been done in Egypt, Ancient Greece and was covered in the Bible (Good Samaritan)

Picture 2: The binding of a battlefield wound depicted on ancient Greek pottery

There are numerous references to First Aid being performed within the Roman army, with a system of first aid, supported by surgeons, field ambulances, and hospitals. In Middle Ages, religious knights trained in medical care and organised a hospital of the knights order to specifically treat battlefield injuries and perform social care, for instance the Order of St. Lazarus of Jerusalem, and in 1099 the Order of St. John (still the charge of the military hospitallers of Malta today). Later the Order of German Knights came about in 1190, and by 1233 the Czech the Order Of Knights with Red Stern.

As one could easily imagine, a major aspect First Aid in these early years involved warfare. The lack of medical care on the battlefield usually meant that wounded men usually died of their injuries. *Napoleon*'s surgeon, *Baron Dominique-Jean Larrey* is credited with creating the first dedicated ambulance corps (the Ambulance Volantes), the back bone of which consisted of medical assistants, tasked with administering battlefield care. This monument in medical and military history is the foundations of the modern method of army surgery, field hospitals and the system of the army ambulance corps. After seeing the speed with which the carriages of the French *flying artillery* manoeuvred across the battlefields, Larrey adapted them as *Flying Ambulances* for rapid transport of the wounded to the rear of the line. He manned them with trained crews of drivers, corpsmen and litter bearers, thereby increasing the mobility and organisation of field hospitals – effectively creating a forerunner of the modern MASH and MERT units. He established rules for triage: treating casualties according to the severity and urgency of their injuries, regardless of rank or nationality. Soldiers of enemy armies, as well as those of the French and their allies, were treated alongside one another. (source Wikipedia).

Florence Nightingale (1820 –1910), famed as the "Lady with the Lamp" was a nurse during the Crimean War. She gained a place in history for spending her night rounds giving personal care to the wounded (hence the image of the lamp) and was instrumental in provoking an acute awareness among her nurses of the unsanitary conditions at British field hospitals. Her interventions reduced the death count by two-thirds! Nightingale's writings sparked worldwide health care reform and by 1860 she had established St. Thomas' Hospital and the Nightingale Training School for Nurses.

Picture 3: Lady with the Lamp, Florence Nightingale

The Crimean War was also a pivotal point in medical development on the opposite side of the battlefield. Nikolai Ivanovich Pirogov (1810 – 1881) gained the greatest of reputations, for the introduction and teaching of applied topographical anatomy in Russia and was also one of the first doctors in Europe to use ether as an anaesthetic. (He described per rectal ether anaesthesia in 1847.) He is now mainly remembered for his introduction of an osteoplastic operation for amputation of the foot. Pirogov's work

during the Crimean War is of such importance that he may be considered the founder of field surgery. He was also credited with devising the plaster cast in 1851 after allegedly observing the work of a sculptor. Along with his breakthroughs in amputation the Sevastopol campaign served as a proving ground for the introduction and mass use of anaesthetic in surgical operations at the front. His experiences in field surgery, published in German in 1864, became a standard reference. Besides his personal efforts for the wounded, Pirogov organised the training of nurses (see more at *http://www.whonamedit.com/doctor.cfm/2627.html*).

In 1859 *Jean-Henri Dunant* witnessed the aftermath of the *Battle of Solferino*, and his work led to the formation of the *Red Cross*. He pushed for its creation at the First International Geneva Convention held, and the resultant organisation was officially created; tasked by the legend: "aid to sick and wounded soldiers in the field."

(see more at *http://en.wikipedia.org/wiki/International_Red_Cross_and_Red_Crescent_Movement*).

Picture 4: Henry Dunant

The Red Cross and Red Crescent are now the largest providers of First Aid worldwide. The movement consists of several distinct organisations that are legally independent from each other, but are united through common basic principles, objectives, symbols, statutes and governing organisations. The movement's parts are:

The International Committee of the Red Cross (ICRC) – a private humanitarian institution founded in 1863 in Geneva, Switzerland, by Henry Dunant and Gustave Moynier. Its 25-member committee has a unique authority under international humanitarian law to protect the life and dignity of the victims of international and internal armed conflicts. The ICRC was awarded the Nobel Peace Prize on three occasions (in 1917, 1944 and 1963). [4]

The International Federation of Red Cross and Red Crescent Societies (IFRC) was founded in 1919 and today it coordinates activities between the 188 National Red Cross and Red Crescent Societies within the Movement.

Czech Red Cross dates back to 1919 when the first Local Association of the Czechoslovak Red Cross was founded in Hradcany by daughter of the first Czechoslovak president, Dr. Alice Masarykova.

1.1. History of Civil First Aid

In the beginning, organised first aid was based on voluntary organisations. During the late 18th century, drowning as a cause of death was a major concern amongst the population and thus In 1767, a society for the preservation of life from accidents in water was started in Amsterdam, and in 1773, physician William Hawes began publicising the power of artificial ventilation as a means of resuscitation of those who appeared drowned. This led to the formation, in 1774, of the Society for the Recovery of Persons Apparently Drowned (later the Royal Humane Society) who did much to promote resuscitation. The St John Ambulance Brigade was formed in 1887, as a voluntary organisation offering free medical care and later on teaching first aid among population. In historic Czech Lands, "Vlastenecký pomocný spolek pro Království české (Patriotic Auxiliary Society for Czech kingdom)" was founded in 1868 and worked along the same principals of the Red Cross. The manual “Methods of Resuscitation of the Seemingly Dead“ was published by Karel Ploc in 1897.

1.2. History of Organised Emergency Medical Services

The first use of the ambulance as a specialised vehicle in battle came about with the ‘Ambulances Volantes’ designed by Dominique Jean Larrey (see above). In civilian life a major advance was made toward the use of ambulances with the introduction of a transport carriage for cholera patients in London during 1832 (in future years this would come to shape policy on hospitals and ambulances). A statement on the carriages, as printed in The Times newsaper, said "The curative process commences the instant the patient is put in to the carriage; time is saved which can be given to the care of the patient; the patient may be driven to the hospital so speedily that the hospitals may be less numerous and located at greater distances from each other." This tenant of ambulances providing instant care, allowing hospitals to be spaced further apart, displays itself in modern emergency medical planning (source Wikipedia).

The predecessor of Prague's emergency medical service, referred to as the Prague Volunteer Protection Unit, was established as early as 1857 making it, together with the Budapest-based predecessor of emergency service, one of the oldest emergency units within Europe. Indeed, the earliest emergency medical service was reportedly the rescue society founded by Jaromir V. Mundy (Born in Brno, Czech Republic), Count J. N. Wilczek, and Eduard Lamezan-Salins in Vienna after the disastrous fire at the Vienna Ring Theatre in 1881. Named the "Vienna Voluntary Rescue Society," it served as a model for similar societies worldwide.(see more at *http://cdn.intechopen.com/pdfs-wm/31945.pdf*).

In June 1887 the St John Ambulance Brigade was established to provide first aid and an ambulance service at public events in London. It was modelled on a military-style command and discipline structure.

Advances in the 1960s, especially the development of CPR and defibrillation as the standard form of care for out-of-hospital cardiac arrest, along with new pharmaceuticals, led to changes in the tasks the ambulances could undertake.

1.3. History of Star of Life

The Star of Life is a blue, six-pointed star, outlined with a white border which features the rod of Asclepius in the centre, originally designed and governed by the U.S. National Highway Traffic Safety Administration (NHTSA) (under the United States Department of Transportation, DOT). Traditionally in the United States the logo was used as a stamp of authentication or certification for ambulances, paramedics or other EMS personnel. Internationally, it represents emergency medical services (EMS) units and personnel.

The six branches of the star are symbols of the six main tasks executed by rescuers all through the emergency chain (source Wikipedia):

1. Detection: The first rescuers on the scene, usually untrained civilians or those involved in the incident, observe the scene, understand the problem, identify the dangers to themselves and the others, and take appropriate measures to ensure their safety on the scene (environmental, electricity, chemicals, radiation, etc.).
2. Reporting: The call for professional help is made and dispatch is connected with the victims, providing emergency medical dispatch.
3. Response: The first rescuers provide first aid and immediate care to the extent of their capabilities.
4. On scene care: The EMS personnel arrive and provide immediate care to the extent of their capabilities on-scene.
5. Care in transit: The EMS personnel proceed to transfer the patient to a hospital via an ambulance or helicopter for specialized care. They provide medical care during the transportation.
6. Transfer to definitive care: Appropriate specialized care is provided at the hospital.

Picture 5: Star of Life

2. Action at the Site of a Medical Emergency

2.1. Safety

When attending an accident, check that the scene of the accident is safe. Your personal safety is paramount or you may compound the problem rather than contribute to its solution. Accident scenes are dangerous places and the dangers come in several guises: road traffic accidents, fires, explosion hazards, chemical hazards and drowning etc...

Assess the scene

- What is the likely scale of injury in terms of numbers and severity?
- Is the road safe or is oncoming traffic a further threat?
- Is there fire, chemical spillage or risk from ruptured fuel tanks?
- Is there chaos or order?
- Are the emergency services already in attendance?
- Have an aura of calm, competence and authority. Do not be afraid to organise people.

Protect the scene:

- One risk is that oncoming traffic may plough into those there. It may be best to park obliquely behind the incident to fend off oncoming traffic.
- Leave on hazard lights.
- If you have access to a high visibility jacket, wear it (carrying a high visibility jacket in an automobile is compulsory in Czech Republic). Remember that you are no use to anybody if you become a casualty too!
- Protect yourself: cover exposed skin, wear gloves and a hard hat if available.
- Unless people are trapped or unable to move, get them off the road and out of the way of further harm. Get them to place warning triangles in both directions.
- Has anyone called the emergency services? If not, make a very brief survey of the scene to be able to give them more information but do not delay getting help. If the emergency services have been called, who has been called? The ambulance service is obvious. However, the police may be required to make the area safe and the fire service may be required if there is a need to extract victims from vehicles, tackle fires or deal with other hazards like chemical spillage.
- For more details on chemical and other hazards, see appropriate chapters.

2.2. Technical first aid

Once again, when attending an accident, check that the scene of the accident is safe. If you have access to high visibility clothing, wear it. Sometimes technical measures must be done first, before approaching victims. There are a number of hazards that may need to be considered for personal safety and that of others.

Park safely so that your car doesn't cause an obstruction, especially for the emergency services. Prevent involved vehicles from unexpected movement as this could lead to destabilisation of an otherwise controlled environment.

You can Achieve this by stabilising the vehicle where it lies by means such as chogging the wheels, or applying the hand break if it is still functioning. Make the vehicle safe: switch off the ignition, disconnect the battery if you are able to do so and swill away any petrol with whatever non flammable fluid you have to hand.

The easiest and most conventional way to enter a car is through the door, so try this before calling for the removal of the windscreen or roof.

Ensure nobody at the scene of the accident is smoking or produces a naked flame. Even if there is no obvious sign of a fuel spillage a "strict non-smoking rule" should still be enforced. If any engine in the involved scene is still running, switch off the ignition.

If electricity cables are brought down by the collision, it is necessary to telephone 112 to ensure that the source is turned off. Remember that high voltage power lines can be lethal, even when standing several meters away.

Trains may be stopped by signal lights, red flags, or a series of small charges placed on the tracks. The noise of them exploding as the train travels over them warns the driver to make an abrupt stop.

Do not approach a chemical incident until declared safe by the fire service.

2.3. Medical First Aid

From the point at which an emergency occurs to the commencement of hospital care, various persons and institutions cooperate intensively. This ‘prehospital’ process is called the "rescue chain". It consists of

1. Recognise emergency situation and perform immediate lifesaving measures (resuscitation, severe external bleeding control)
2. Emergency Call.
3. First Aid.
4. Medical First Aid at the Site and Transport.
5. Definitive Medical Treatment.

The individual elements of the rescue chain interlock like real chain links and aim to give the aid required to victims already at the accident scene and to make sure that they receive medical treatment within the shortest time frame possible. First responders and passerby’s are only involved in the first three steps of the rescue chain. At the end of the chain, professional rescue services combine Emergency Medical Care with transport to a hospital. It is with this step that initial medical care can be started, and finally (on arrival to a dedicated medical facility) where true medical treatment as the hospital doctor would view it can be commenced.

2.4. Immediate lifesaving measures

(source *http://www.sja.org.uk/sja/first-aid-advice/what-to-do-as-a-first-aider/how-to-assess-a-casualty/the-primary-survey.aspx*)

Immediately after finding an injured person, the first aider takes several actions: they include measures to secure the site of the accident or danger zone or to provide emergency life support, such as stopping severe haemorrhages. As a point of note concerning haemorrhage of any kind – when you take care of bleeding wounds, you should wear single-use gloves for your own protection.

The ‘Primary Survey’ is a quick way for you to find out if someone has any injuries or conditions which are life-threatening. If you follow each step methodically, you can identify each life-threatening condition and deal with it in order of priority. Use the letters DR. ABC to remember the steps: Danger, Response, Airway, Breathing and Circulation.

Danger: If someone needs help, before you go up to them check – is it safe?

No:

- If you can see or hear any danger nearby, for you or them, like broken glass or oncoming traffic, then make the situation safe before you get any closer

Yes:

- If you can't see or hear any danger, then it is safe to go up to them.

Response: Do they respond when you ask them: 'Are you alright?' or if you say: 'Open your eyes!'

No:

- If they don't respond, then gently shake their shoulders, or with a child – tap their shoulder, and with a baby – tap their foot. If they still don't respond, then you can presume they're unconscious and move on to the next stage – Airway. Someone who's unconscious should always take priority so you should treat them first and as quickly as possible.

Yes:

- If they respond by making eye contact with you or some gesture, then you know that they're conscious and you can move on to the next stage – Airway.

Airway: Is their airway open and clear?

No:

- Conscious: If they're conscious, treat them for conditions that may be blocking their airway, such as choking. Only move on to the next stage – Breathing – once their airway is open and clear.
- Unconscious: If they're unconscious, tilt their head and lift their chin to open their airway. Only move on to the next stage – Breathing – once their airway is open and clear.

Yes:

- If their airway is open and clear, move on to the next stage – Breathing.

Breathing: Are they breathing normally? You need to look, listen and feel to check if they're breathing or not.

No:

- Conscious: If they're conscious, treat them for whatever is stopping them breathing, for example, an obstructed airway. Then go to the next stage – Circulation
- Unconscious: If they're unconscious and not breathing, call for an ambulance, or get someone else to call if possible, and start giving chest compressions and rescue breaths (CPR – cardiopulmonary resuscitation). If this happens you probably won't move on to the next stage as the casualty needs resuscitation.

Yes:

- If they are breathing normally, move on to the next stage – circulation.

Circulation: Are there any signs of severe bleeding?

Yes:

- If they're bleeding severely, control the bleeding with gloved fingers, a dressing or clothing, call the emergency service number (112 is the standard emergency service number in the European Union and is multilingual – 155 is the number for the Czech ambulance service). Ask for an ambulance and treat the patient to reduce the risk of them going into shock.

No:

- If they aren't bleeding, and you're sure you have dealt with any life-threatening conditions, then you can move on to the 'Secondary Survey', to check for any other injuries or illnesses.

2.5. Emergency call

When the injured party is well secured and has received appropriate first aid, the emergency call is made to alert the rescue service. For such cases, it is good to know the emergency call numbers by heart and to store them on your mobile phone. Many new sim cards in the Czech Republic have them already stored when you buy them.

In Czech Republic, you can use the following contacts as they appear in the phone:

- **HASICI (fire service)** **150**
- **POLICIE (the police)** **158**
- **ZACHRANKA (ambulance)** **155.**
- **INTEGRATE RESCUE SYSTEM** **112**

Note that the final number, 112, is the European emergency phone number, available everywhere in the EUROPE, free of charge. It is possible to call 112 from fixed and mobile phones to contact any emergency service: an ambulance, the fire brigade or the police. It is the same in all European countries and is given absolute priority in the telephone network. You can make this call with an unregistered sim card, a phone with no credit and from any cell-operator. The outgoing calls are routed to the nearest control centre, whether it be in the Czech Republic or any other European country. This line is able to hold a callers ID, even from a Mobile phone, and can also triangulate your approximate position via mobile telephone mast signals.

IF YOUR MOBILE PHONE HAS A SPEAKER FACILITY SWITCH IT TO LOAD SPEAKER as this will facilitate continuous dialogue with the dispatcher instructions.

To ensure that help comes as quickly as possible, you should give the following information to the dispatcher:

1. Where is the site of the accident? Indicate the city, street, number, street corner, or kilometre marker if you are on a highway.
2. What happened? Traffic accident, fire, accident involving electricity...? Are the injured persons trapped in a car? Is the road blocked? Is a lorry carrying dangerous goods involved? Is there a necessity for another branch of the emergency services (for extrication etc.)?
3. How many persons are injured?
4. What are the main symptoms?
5. In case of the air rescue service, describe weather conditions and landmarks for landing.
6. Who has made the call? Indicate your own name and telephone number.
7. Never hang up first, wait for further instructions

2.6. Integrated Rescue System of the Czech Republic

The Integrated Rescue System (IRS) is determined for coordination of rescue and clean-up operations in case of a situation that requires cooperation of several branches of the emergency services, e.g. firefighters, police, medical rescue service and other bodies. There can also be circumstances where the rescue operation and subsequent clean-up must be coordinated via the Ministry of the Interior, or by a relevant governor of a region or municipality with extended responsibilities. (source *http://www.hzscr.cz/hasicien/article/about-us-scope-of-activities-integrated-rescue-system.aspx*).

Basic (standard) IRS bodies:

- Fire Rescue Service of CR and fire units, based on fire cover – 150,
- Police of CR – 158,
- Medical Rescue Service – 155.

Other IRS bodies are activated only in some situations:

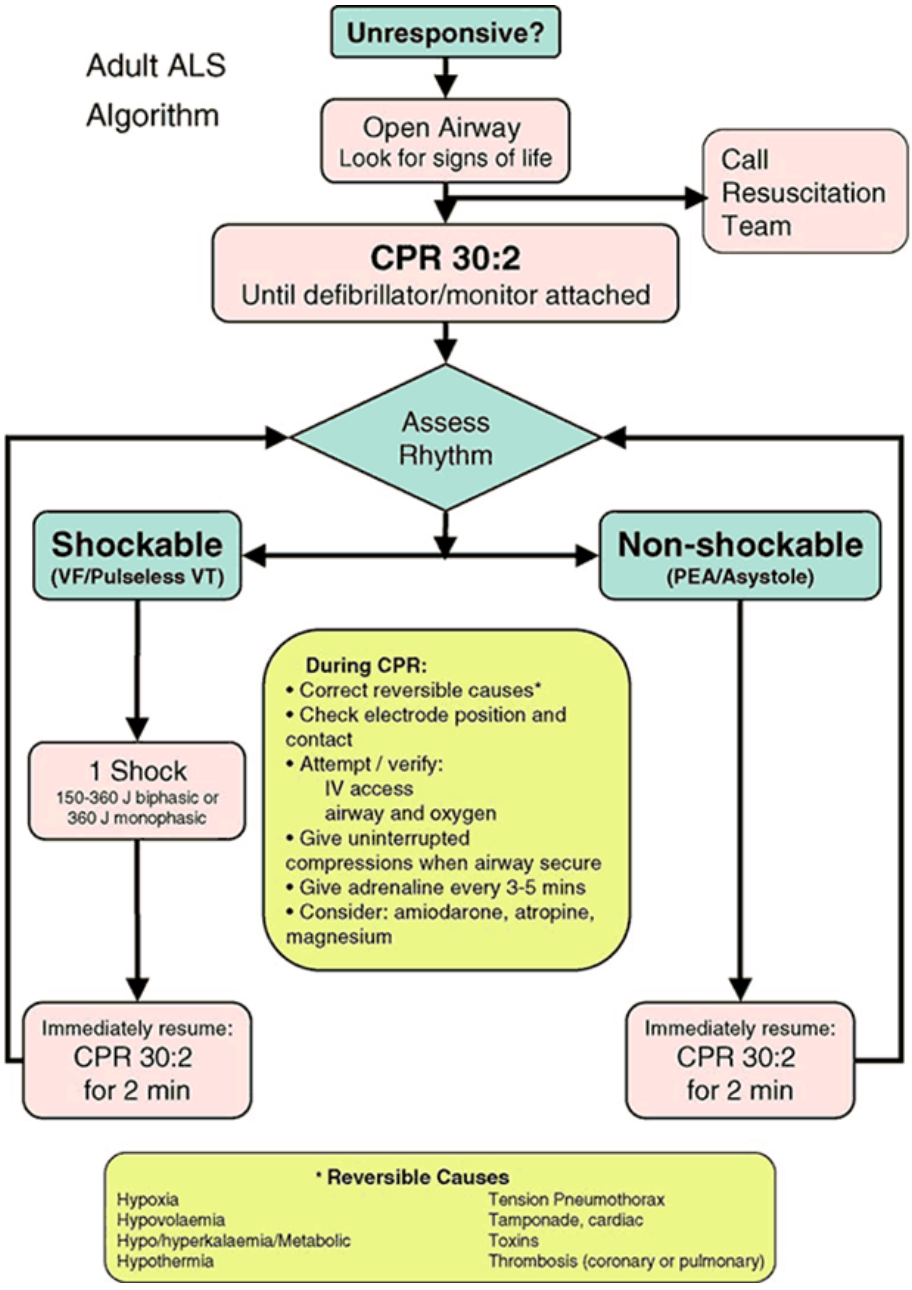
- Specified forces and means of armed bodies,
- Other armed security services,
- Other rescue services,
- Public health protection authorities,
- Emergency, stand-by, specialised and other services,
- Civil Protection establishments,
- NGOs and civil associations, which can be used for rescue and cleanup operations.

As permanent authorities for coordination of Integrated Rescue System bodies are considered the operational and information centers of the Integrated Rescue System, i.e. the operational centers of regional Fire Rescue Services and the Operational and Information Centre of the General Directorate of the Czech Fire Rescue Service

3. Resuscitation

Resuscitation is a well documented and often reviewed mode of first aid. It is a dynamic process that involves the combination of skills of observation, management and at the level of a medical care provider, an understanding of the pathophysiological changes taking place within the unresponsive patient. For a video depicting the process of so called "A,B,C resuscitation" please refer to this page on the Third Faculty of Medicine's website http://www.lf3.cuni.cz/en/resuscitation/
For a written description please click the following link, also sourced to the Anaesthesiology department of the Third Faculty of Medicine, Charles University.

The following diagram is from ERC guidelines 2015 – 2020 for resuscitation and shows a comprehensive work flow that is beneficial to be acquainted with.



Picture 6: Adult ALS Algorithm

http://www.lf3.cuni.cz/en/advanced-resuscitation/

4. Shock

Definition: Shock is failure of the circulatory system to provide the organ perfusion and tissue oxygenation required to meet cellular metabolic demands. The most common signs are hypotension and tachycardia. The circulatory system consists of three main parts:

1. The heart muscle as pump.
2. The blood vessel's capacity and volumetric component.
3. Circulating blood – making up the content of the system and being the functional unit of oxygenation.

Disturbance may appear in any part and this system, and as such it gives us a basis to define different types of shock by how they modulate these perimeters:

- **Hypovolemic** shock, secondary to haemorrhage, loss of fluid ceased by burns, dehydration etc.
- **Obstructive** shock (obstacle to blood flow caused by massive pulmonary embolism, tension pneumothorax, heart tamponade etc.)
- **Cardiogenic** shock (loss of capacity to pump blood – e.g. acute heart attack, cardiomyopathy).
- **Distributive** shock, including Neurogenic shock and Anaphylactic shock (dilatation of blood vessels caused by loss of sympathetic nerve system supply after high spinal cord injury, or anaphylaxis)
- **Mixed** form (eg. Septic shock – combination of hypovolemic, cardiogenic and distributive shock)

4.1. Hypovolemic shock

Hypovolemic shock is the most common type of shock.

Causes: The main causes of hypovolemia are bleeding, major burn injury and dehydration (ileus, diarrhoea, hyperthermia). The most vulnerable organs are the kidneys, liver, lungs, and gut but always keep in mind that the ultimate mechanism of death is brain hypoxia. The initial physiological response to shock includes the release of adrenaline and noradernaline to promote tachycardia and vasoconstriction of non-essential, ischaemia tolerant vascular beds (skin, muscles, kidneys, gastrointestinal tract). This effectively centralises the oxygenated blood in the body, meaning the most important regions of the body, such as the brain and heart are bathed in oxygen rich blood for as long as possible. This phase is described as compensated shock, or centralised circulation. Decompensated shock occurs when the physiological response fails to maintain normotension. In cases where there is heavy loss of blood, for instance, meaning that compensation is inadequate to maintain perfusion and the adaptive response fails the body begins to decompensate. This decompensated phase of shock is irreversible, and occurs when prolonged hypotension, severe acidosis and coagulopathy become unresponsive to fluid and drug therapies, ultimately leading to death. Note that this is not a manual of pathophysiology, but suffice to say that the acidosis incurred in peripheral ischemia forces the dilation of peripheral blood vessels, and then leeds to a dramatic drop in central blood preasure – rendering both the brain and heart hypoxic.

Signs and symptoms of hypovolemic shock

- A rapid, weak, thready pulse due to decreased blood flow combined with tachycardia
- Cool, clammy skin due to stimulation of vasoconstriction
- Rapid and shallow breathing due to sympathetic nervous system stimulation and acidosis
- Hypothermia due to decreased perfusion and evaporation of sweat
- Thirst and dry mouth, due to fluid depletion
- Decreased urine production, urine concentration
- Cold sweat because of circulating adrenaline
- Fatigue
- Disturbances of consciousness as a late sign

Note that in the hospital setting, only heart rate and urine output can be quantifiably measured at the bedside.

Blood loss	Sign	Treatment
<15 % (0.75 litres)	mild increase of heart rate, normal blood pressure	minimal
15-30 % (0.75-1.5 litres)	fast heart rate. low blood pressure	intravenous fluids
30-40 % (1.5-2 litres)	very fast heart rate, low blood pressure, confusion	fluids and transfusion
>40 % (>2 litres)	critical blood pressure and heart rate	aggressive interventions

Table: an estimation of blood loss according to signs.

First aid interventions in Hypovolemic shock:

Definitive treatment is possible only in a hospital. Treatment must be aggressive and rapid. Sometimes the terms 'golden hour' or 'platinum 30 minutes' are used to underline the time factor decisive for successful treatment of a shock patient. The single aim is to restore oxygenation of organs, but note that this is not achieved by giving blood as is the common misconception. In order to keep oxygenation, you must maintain the ability of blood to circulate, thus maintain the integrity of the whole system. This is achieved by restoring circulating volume. To rephrase: Blood pressure is the key stone of cardiac output and oxygenation.

Because of centralisation of circulation, all fluids and drugs must be administered intravenously. No food or drink must be given per os. There is an increased risk of hypothermia, bed sores etc. because of hypoperfusion of periphery, but in an acute patient these are not of key concern.

Outside of the hospital setting, essential components of first aid treatment are:

- prevent further blood loss (see chapter *5 Bleeding*)
- call EMS
- immobilisation of fractures (provides analgesia and decreases bleeding)
- treatment of further injuries to improve comfort
- anti-shock position (supine position with elevated extremities)
- prevention of hypothermia (e.g. by aluminium foil from the first aid kit)
- prevention of pressure sores by padding all vulnerable parts
- observation until EMS arrives

Definitive therapy: In case of haemorrhage shock the first step is to stop bleeding by acute surgery and by administering intravenous fluids for volume replacement (crystalloids or colloids). In blood loss exceeding 1500 ml in adults, a blood transfusion is necessary.

REMEMBER: LOSS OF ERYTHROCYTES IS BETTER TOLERATED THAN LOSS OF TOTAL CIRCULATING VOLUME. In the case of hypovolemic shock, infusions are administered according to the type of fluid loss. Usually artificial ventilation and pharmacotherapy are performed.

4.1.1. Infusion therapy – blood substituents

Definition: Intravenous fluid that should replace blood loss. These fluids do not usually have capacity for transport of oxygen, but an organism will tolerate low haemoglobin far better than low circulating volume.

Classification

- Crystalloids – water solution of ions
- Colloids – solution of substances with high molecular weight (gelatine, starch)
- Blood Substituents – modified haemoglobin, fluorohydrocarbons

Crystalloids (normal saline, Ringer solution, Hartmann solution, Isolyte, Plasmalyte etc.)

Advantages: no risk of allergic reaction and easily available.

Disadvantages: absence of capacity for oxygen transport, they easily cross capillary membrane and escape from the circulation to extra- and intracellular space (1 litre of saline increases circulating volume by cca 200 ml)

Colloids

Advantages: easily available, and do not escape from vessels. (in theory 1 litre of fluid administered to the body should increases circulating volume by about 1 litre, but in practice this is hard to achieve.)

Disadvantages: absence of capacity for oxygen transport and absence of haemocoagulation factors. There is a risk of allergic reaction and therefore even with the advantage of volume, crystalloids are usually preferred. There is also a risk of interference with blood coagulation and risk of nephrotoxicity.

Blood substituents

Advantages: the ability to transport oxygen, compared to blood there is a longer shelf life, and also there are no problems with blood group mismatch.

Disadvantages: Fluorohydrocarbons: have been tested since the 1960s, and have a good record of not passing the capillary membrane, but Modified haemoglobin is a new beast and has only recently been under research. (see *http://en.wikipedia.org/wiki/Haemoglobin-based_oxygen_carriers*)

4.1.2. Transfusions

Definition: Transplantation of blood or blood components from a healthy donor to recipients to supply blood or some of its components.

Indication: Critical anaemia and/or haemocoagulation disorders.

Contraindication: Any transfusion that is not strictly indicated (purposeless transfusion), lack of consent of an adult.

Risks: Haemolytic reaction, circulation overloading, fever, disturbances of immunity, infection, allergic reaction, hypothermia.

REMEMBER
Is blood transfusion necessary in this patient?
If so, ensure:

- right blood
- right patient
- right time
- right place

The United Kingdom's NHS has a wealth of information aimed at patients, and the following text is sourced from a patient handout given to help clinitians explain to potential donors and recipients what a blood transfusion is, its merits, risks and the intended clinical outcome:

(source *http://www.transfusionguidelines.org.uk/transfusion-handbook*)

Blood groups

There are more than 300 human blood groups but only a minority cause clinically significant transfusion reactions. The two most important in clinical practice are the ABO and Rh systems.

Blood group antigens

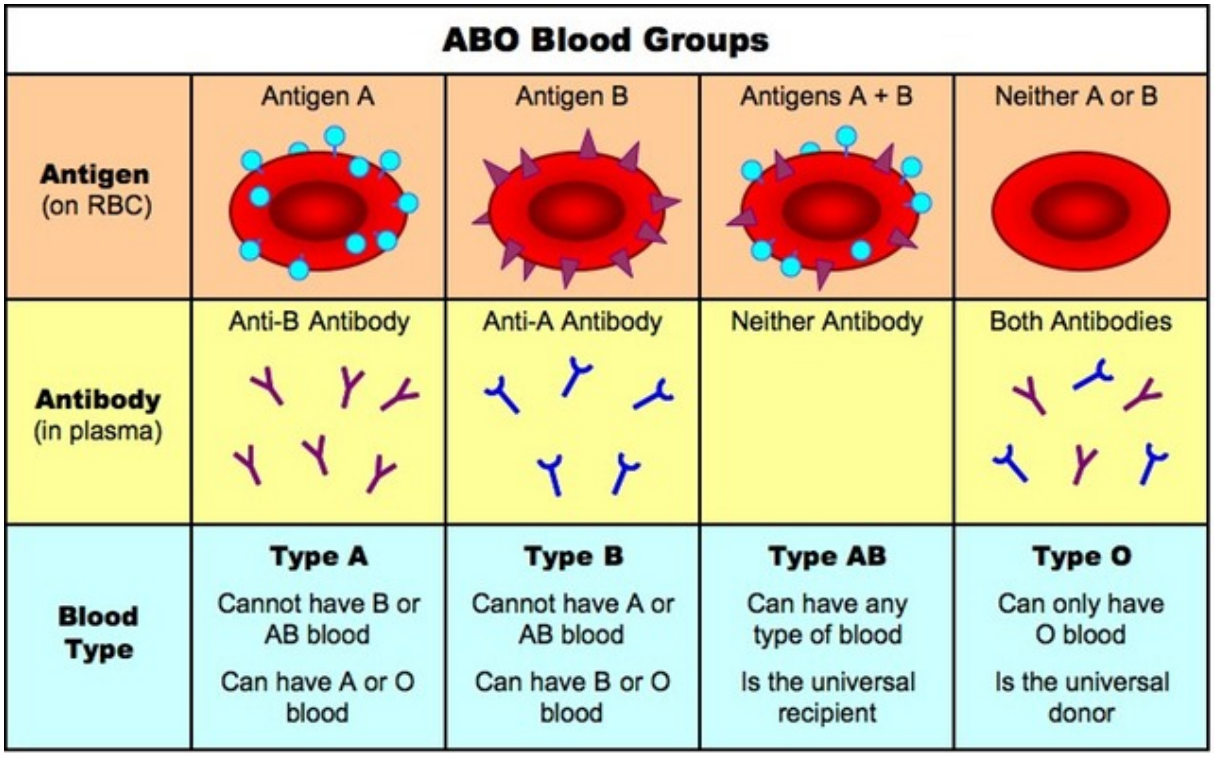
Blood group antigens are molecules present on the surface of red blood cells. Some, such as the ABO groups, are also present on platelets and other tissues of the body.

Blood group antibodies

These are usually produced when an individual is exposed to blood of a different group by transfusion or pregnancy ('alloantibodies'). This is a particular problem in patients who require repeated transfusions.

The ABO system

There are four main blood groups: A, B, AB and O. All normal individuals have antibodies to the A or B antigens that are not present on their own red cells. The frequency of ABO groups varies in different ethnic populations and this must be taken into account when recruiting representative blood donor panels. Individuals of blood group O are sometimes known as universal donors as their red cells have no A or B antigens. However, their plasma does contain anti-A and anti-B that, if present in high titre, has the potential to haemolyse the red cells of certain non-group O recipients (see *Picture 7*).



Picture 7: ABO Blood Groups (source **http://www.ib.bioninja.com.au)**

Transfusion reactions due to ABO incompatibility

ABO-incompatible red cell transfusion is often fatal and its prevention is the most important step in clinical transfusion practice. Anti-A and/or anti-B in the recipient's plasma binds to the transfused cells and activates the complement pathway, leading to destruction of the transfused red cells (intravascular haemolysis) and the release of inflammatory cytokines that can cause shock, renal failure and disseminated intravascular coagulation (DIC).

Usually the same bool group is transfused to the patient. In case of emergency and risk of bleeding to death, group 0 and plasma AB are transfused without waiting for tests of compatibility.

The most commonly used transfusion components are

- concentrated erythrocytes
- fresh frozen plasma (with some haemocoagulation factors)
- concentrated thrombocytes

Practical approach (source *http://www.transfusionguidelines.org.uk/transfusion-handbook*)

Video 1: Technique of blood transfusion

Practical method of transfusion and key points of note.

- Transfusion should only be used when the benefits outweigh the risks and there are no appropriate alternatives.
- Results of laboratory tests are not the sole deciding factor for transfusion.
- Transfusion decisions should be based on clinical assessment underpinned by evidence-based clinical guidelines.
- Not all anaemic patients need transfusion (there is no universal 'transfusion trigger').
- Discuss the risks, benefits and alternatives to transfusion with the patient and gain their consent.
- The reason for transfusion should be documented in the patient's clinical record.
- Timely provision of blood component support in major haemorrhage can improve outcome – good communication and team work are essential.
- Failure to check patient identity can be fatal.
- Confirm identity at every stage of the transfusion process. Any discrepancy, DO NOT TRANSFUSE.
- The patient must be monitored during the transfusion.
- Education and training underpin safe transfusion practice.

1. Before the transfusion

   Where possible, patients (in paediatrics, the patient's guardian or parent) should have the risks, benefits and alternatives to transfusion explained to them in a timely and understandable manner. An informed consent must be obtained from adults and either consent or refusal must be documented. Minimum dataset in patient's clinical record:

   - Reason for transfusion (clinical and laboratory data).
   - Summary of information provided to patient (benefits, risks, alternatives) and patient consent.
   - Requests for transfusion Must include:

- Minimum patient identifiers and gender
- Diagnosis, any significant co-morbidities and reason for transfusion
- Component required, volume/number of units and special requirements
- Time and location of transfusion
- Name and contact number of requester.
- Blood samples for pre-transfusion testing

2. Blood sampling

- A 5–10ml venous blood sample is taken from the patient via labelled vial with special anticoagulant agent.
- The vial must be labeled according to identification of patient, date of sampling, and department.
- The transfusion 'prescription' must contain the minimum patient identifiers and specify:
  - Components to be transfused
  - Date of transfusion
  - Volume/number of units to be transfused and the rate or duration of transfusion
  - Special requirements (e.g. irradiated, CMV negative).
- All patients being sampled must be positively identified.
- Collection of the blood sample from the patient and subsequent sample labelling must be a continuous, uninterrupted event involving one patient and one trained and competency assessed healthcare worker.
- Sample tubes must not be pre-labelled.
- The request form should be signed by the person collecting the sample.

3. Laboratory testing

The patient's pre-transfusion blood sample is tested to determine the ABO and RhD groups. The plasma is also screened for the presence of red cell alloantibodies capable of causing transfusion reactions. Antibody screening is performed using a panel of red cells that contains examples of the clinically important blood groups most often seen in practice.

Blood units of a compatible ABO and Rh group, negative for any blood group alloantibodies detected, can then be selected from the blood bank, taking into account any special requirements on the transfusion request. Traditionally, the final step in providing safe blood is to carry out a serological crossmatch between the patient's plasma and a sample of red cells from the units of blood selected for transfusion. Indeed blood units (or blood bags) have special capillary lines containing small samples of the same blood contained within the bag itself, that can be removed and used to test blood compatibility.

4. Collection and delivery of blood component to clinical area

- Before collection, ensure the patient and staff are ready to start transfusion and that there is good venous access.
- Only trained and competent staff should collect blood from transfusion laboratory or satellite refrigerator.
- Authorised documentation with minimum patient identifiers must be checked against label on blood component.
- Minimum patient identifiers, date and time of collection and staff member ID must be recorded.
- Deliver to clinical area without delay.

5. Administration to patient

- The final check must be conducted at the bedside by a the same trained and competent healthcare professional that administers the blood unit. Usually two healthcare professionals must be present: in the Czech Republic a nurse and a doctor, in other countries two nurses.

Picture 8: Test area of a modern blood pack, non continuous with the blood unit itself, but containing the same blood for crossmatch testing prior to transfusion (source https://en.wikipedia.org)

- All patients having a transfusion must be positively identified.
- Minimum patient identifiers on the patient's identity band must exactly match those on blood component label.
- Check the expiry date of the component and ensure the donation number and blood group on the pack matches that on the laboratory-generated label attached to the pack.
- Any special requirements on the transfusion prescription, such as irradiated component, must be checked against the label on the pack.
- Inspect the component pack for signs of leakage, discolouration or inconsistent viscosity.
- All components must be given through a blood administration set (170–200 μm integral mesh filter).
- Transfusion should be completed within 4 hours of leaving controlled temperature storage

6. Monitoring the patient

- Patients should be under regular visual observation and, for every unit transfused, minimum monitoring should include:
- Pre-transfusion pulse (P), blood pressure (BP), temperature (T) and respiratory rate (RR), in CZ also urine examination
- Results of biological test
- P, BP and T 15 minutes after start of transfusion – if significant change, check RR as well.
- If there are any symptoms or signs of a possible reaction – monitor and record P, BP, T and RR and take appropriate action.

- Post-transfusion P, BP and T – not more than 60 minutes after transfusion completed.
- Inpatients are to be observed over the next 24 hours and outpatients are advised to report late symptoms as they develop (they are given 24-hour access to clinical advice).

7. Further action

- If further units are prescribed, repeat the administration/identity check with each and every unit.
- If no further units are prescribed, remove the blood administration apparatus and ensure all transfusion documentation is completed.

8. Safety tests performed at the bedside

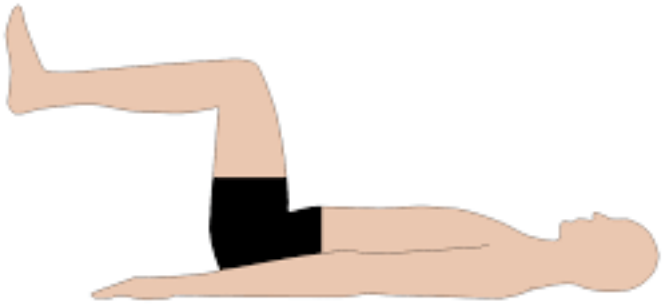
- In the Czech Republic, SANGVITEST or HAEMO BED-SIDE TEST is used before transfusion: blood drops from the transfusion bag and from the patients are mixed with special antibodies to confirm if blood group of patients and blood group in the bag are the same.
- A biological test is the last chance to prevent serious acute reactions (see below). 20ml of blood is transfused as quickly as possible and then immediately after this, the transfusion is stopped for 1–2 minutes and the patient is observed for any sign of adverse reaction. If no reaction is present, the biological test is repeated twice more and if everything is all right, the transfusion may continue.
- Note that this is a very stringent measure, and in countries other than the Czech Republic, only the patient´s vital signs are monitored at 15 minute intervals.

Acute transfusion reactions
Acute transfusion reactions (ATRs) present within 24 hours of transfusion and vary in severity from mild febrile or allergic reactions to life-threatening events. They include:

- Febrile non-haemolytic transfusion reactions – usually clinically mild.
- Allergic transfusion reactions – ranging from mild urticaria to life-threatening angioedema or anaphylaxis.
- Acute haemolytic transfusion reactions – e.g. ABO incompatibility.
- Bacterial contamination of blood unit – symptoms range from mild pyrexial reactions to rapidly lethal septic shock depending on the bacteria.
- Transfusion-associated circulatory overload (TACO).
- Transfusion-related acute lung injury (TRALI).

Acute haemolytic reactions
The most serious reactions are caused by transfusion of ABO-incompatible red cells which react with the patient's anti-A or anti-B antibodies. There is rapid destruction of the transfused red cells in the circulation (intravascular haemolysis) and the release of inflammatory cytokines. The patient often quickly falls into shock and may develop acute renal failure as well as disseminated intravascular coagulation (DIC). The margin of error in this case is very small – note that transfusion of less than 30ml of blood group A to a group 0 patient has proven fatal. It characteristically begins with an increase in temperature and pulse rate. Symptoms may include chills, rigors, dyspnoea, chest and/or flank pain, discomfort at infusion site, sense of dread, abnormal bleeding. As stated earlier, patients may progress rapidly into shock, causing instability of blood pressure, development of oliguria, haemoglobinuria and haemoglobinaemia.

In anaesthetised patients, hypotension and evidence of disseminated intravascular coagulation (DIC) may be the first signs. This may be a fatal reaction.



Picture 9: Position in Hypovolemic Shock (preferable with legs at a high orientation compared to the heart)

4.2. Cardiogenic shock

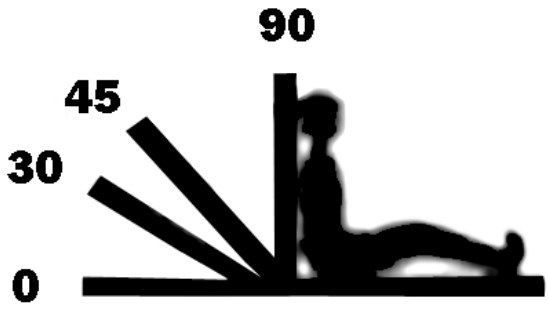
Causes: Inability of myocardium to effectively pump blood. The most common cause is acute myocardial infarction, followed by myocarditis, cardiomyopathy or serious arrhythmias.

History: Heart disease, chest pain and other cardiovascular diseases.

Signs and symptoms: Differ according to the primary cause, e.g. dyspnoea, production of pink sputum, oedemas, cyanosis, dilated jugular veins, irregular pulse and disturbances of consciousness

First aid: Limited to activation of EMS and monitoring of patients. Note that in the opposite case to hypovolemic shock, it sometimes helps to put the legs lower than the heart, as it results in decreased venous return and demands on myocardial work.

Prognosis: Poor.



Picture 10: Position in Cardiogenic Shock (preferable with legs hanging over the side of the bed)

4.3. Septic shock

Causes: Systemic inflammatory response syndrome (SIRS) secondary to a documented infection and arterial hypotension with some evidence of organ dysfunction. This response is a state of acute circulatory failure characterized by persistent arterial hypotension despite adequate fluid resuscitation or by tissue hypoperfusion. Bacterial toxins or bacteria causes damage to capillary wall with leakage of fluid from circulation and some injury to other organs, like myocardium, lungs, kidneys et.

History: Infection, sometimes without apparent source

Signs and symptoms:

- tachycardia (over 90-100/min)
- frequently hypotension
- body temperature > 38 °C (fever),rarely < 36 °C (hypothermia)
- tachypnoea (> 20 breath/min)
- disturbance of consciousness

Septic shock is a state of hypotension in spite of aggressive volume replacement therapy (typically > 6 l or 40 ml/kg crystalloids).

First aid: Limited to activation of EMS and monitoring of patients.

Definitive treatment: Surgical removal of the source of infection, antibiotics, pharmacological support to failing organs. Mortality is high.

4.4. Obstructive shock

Causes: lodging of an embolus, which is usually a blood clot, causing a blockage (vascular occlusion) usually at branches of the pulmonary artery. Less frequently it is fluid or blood in pericardium (cardiac tamponade) limiting filling of ventricles during diastole with blood.

Picture 11: Pulmonary embolism (from public source)

History: Sudden dyspnoea, cough, sometimes syncope. History of long immobilisation, pain in calf, contraceptive pills, cancer etc. In case of cardiac tamponade there was usually previous chest trauma, surgery of heart or large vessels.

Signs and symptoms: dyspnoea, cyanosis, “blue face”, dilated neck veins

First aid: limited to activation of EMS and monitoring of patients.

Definitive treatment: Removal of obstruction (surgery, thrombolysis, under X-ray)

Remark: Minor embolism – see chapter *6.3.6 Pulmonary embolism*

4.5. Neurogenic shock

Causes: High spinal injury leading to loss of sympathetic nerve stimulation and loss of normal vascular tone with sudden vasodilatation.

History: Spinal cord injury

Signs and symptoms: Signs and symptoms of spine injury, pink, warm skin bellow spinal cord lesion, hypotension, in case of high thoracic injury (above T4 injury of nn. accelerantes – bradycardia, in case of high cervical injury (above C4) apnoea and unconsciousness.

First aid: As in spinal injury (see chapter *11.3 Spine and spinal cord injury*), antishock position (see above) and resuscitation if necessary. Activation of EMS.

Definitive therapy: Administration of sympathomimetic drugs.

4.6. Anaphylactic shock

Causes: Serious systemic allergic reaction with release of histamine and other substances leading to vasodilatation, capillary leakage and other organs disturbances (bronchoconstriction, myocardial disturbance etc.)

History: Contact with allergic substances, such nuts, sea food, insect stings, drugs etc. Onset is in seconds to minutes.

Signs and symptoms:

- disturbances of heat rhythm
- hypotension
- tachycardia
- urticaria, red spots on the skin
- oedemas
- breathing problems
- loss of consciousness.

First aid: Call EMS immediately. Before arrival to the emergency department, monitor the patient and reassure him. Oedemas can be deceased by applying cold dressing or sucking ice. Some people known to have severe allergies are given autoinjectors containing adrenaline by their doctors in case of exposure (e.g. EpiPen, Anapen), which must be applied as soon as possible to the outer upper third of thigh. Act according to pictures on the device (see *Picture 12: EpiPen*, *Video 31: How to use EpiPen*). Follow up emergency medical care consists of administration of adrenaline (s.c., i.m., i.v.), corticosteroids, infusions etc. If treatment starts early, prognosis is good. REMEMBER, even after successful EpiPen administration, patients must be admitted to a hospital for 24 hours, anaphylaxis may reappear after several hours.

Picture 12: EpiPen

5. Bleeding

(partly used film SZÚ První pomoc, výroba a distribuce Studio Grant)

Bleeding – Blood escaping from the circulatory system (extravasation) – Bleeding can be classified according to various criteria:

- extent
  - minor – does not need surgical treatment
  - major – needs surgical treatment
- site of bleeding
  - external
  - internal
  - from body orifices
- source of bleeding
  - capillary
  - venous
  - arterial
  - mixed
- mechanism
  - normal – extent of bleeding is proportional to extent of injury
  - abnormal (pathological) – extent of bleeding is larger than expected relative to the injury, commonly seen with patients on anticoagulats (warfarin etc.) or in some inherited diseases such as haemophilia. This bleeding must always be treated by a doctor.

5.1. Treatment of minor bleeding

Minor bleeds are usually self limiting. Before treatment, wash and dry your own hands and use disposable gloves. Standard treatment consists of cleaning the wound or cut, if dirty, under running water, and drying with a sterile dressing or clean, lint-free material. If possible, raise the affected area above the heart. Cover the cut temporarily while you clean the surrounding skin with soap and water and disinfect the surrounding skin. Cover the cut completely with a sterile dressing or plaster. Instruct the patient about possible risks – see chapter *8 Soft tissues injuries.*

5.2. Treatment of major external bleeding

Make treatment of the bleeding wound a priority. Time is of the essence when a deep wound is bleeding profusely. Prevent prolonged and excessive blood loss which can cause Hypovolemic (haemorrhage) shock (see chapter *4 Shock*)

Start coming up with a plan to reach medical personnel after you treat the wound. Expose the entire wound to see the full extent of the injury. Cut, tear, push, and/or lift any clothing away from the wound. If clothing is stuck to the wound, leave that portion in place and work around it. Do not try to wash the wound. Resist the impulse to remove any objects from the wound. You need to use every method at your deHelp the wound to coagulate. Ripping off the portion of clothing stuck to the wound may disturb blood clots and cause more bleeding.

Do not remove objects because they may be having a tamponade or compression effect within the wound. Injured blood vessels, arteries or veins, can clot faster when any type of pressure is applied. Removing an object from the wound may lead to more rapid hemorrhage or blood loss.

Apply a regular dressing over the wound, first. Find the cleanest cloth available if you do not have a first-aid kit. Stabilize any impaled objects sticking out the wound with some of the bandage/cloth before you cover the wound. Secure the dressing in place. Do not manipulate the wound more than necessary. It is okay to protect the wound from further contamination if the area around the victim is dirty. (source *http://www.wikihow.com/Apply-a-Pressure-Bandage*)

Extremity

Put the victim into the supine position. Compress the bleeding site and elevate the bleeding extremity above the level of the injured person's heart. Do not elevate the limb before you splint any broken bones. In an emergency, you can use your bare hands or any clean soft, non fibrous material in order to Improvise a pressure bandage – conversely if you have on at your disposal, use the bandages found in first aid kits (see *Video 2: Severe external bleeding*).

Video 2: Severe external bleeding

Pressure (compression) bandages consist of a cover layer, bandage and compression piece. The compression piece is usually created by employing an unrolled bandage from the first aid kit. Apply cover sterile dressing, fix it with several turns of a roller bandage, and then place the unrolled bandage over the wound. Hold this tight while you wind out the remainder of the roller bandage firmly around the extremity and wound. If there is profuse bleeding, and the first bandage becomes saturated, DO NOT REMOVE IT but simply add more layers to the first dressing. After treatment keep thermal homeostasis and comfort of the victim.

The next possibility to stop bleeding is compression of pressure points. These are points where artery can be compressed manually directly against bone and bleeding distally from compression point stops because of diminished blood flow to the area. The use of pressure point in practice is sometimes difficult, because the victim is usually not naked and also, were the victim in such a convenient state as to allow compression of an artery, the rescuer would then be unable to perform further first aid, because pressure cannot be released. They are usually used in case of bleeding from neck and from subclavian artery where no other methods are possible.

Use of a tourniquet is advised only when no other technique (elevation, manual pressure, or a pressure dressing) has worked. Some years ago, the use of tourniquets was discouraged, but recent experiences by military and mass casualty management (terrorist attacks) has resulted in their renaissance. A tourniquet compresses arteries and veins very firmly. There is very little blood flowing past the point of the tourniquet, thus preventing haemorrhage through the wound. A tourniquet can be fashioned from anything: a belt or long piece of cloth, but specialised instruments are becoming more and more frequent in advanced first aid kits. It is used for limbs only. The best location to wrap the tourniquet is on the thigh or the upper arm; this has to be changed to 10 – 15 cm above the wound if the wound is located on the thigh or the upper arm. This can be hard to accomplish precisely, especially in a catastrophe, so it is prudent to apply the logic that the tourniquet must be closer to the heart than the wound is. It is good practice to put something such as a piece of cloth or the person's clothing under the tourniquet to protect the skin, because unlike a pressure dressing a tourniquet is very, very tightly tied around a limb. You can use a rubber Esmarch's tourniquet from first aid kit or improvise it from a firm strip of cloth approximately 5 cm wide or you could wrap the limb with a rope/belt/bra. Do not apply a tourniquet over a joint – blood passageways are protected in joints, and you'll never put pressure on the arteries. To apply the tourniquet you must secure it in place by using one knot. Within this knot, slide a torsion device (firm stick, solid pen, etc..) and then tie another knot around the stick to keep it from undoing. Apply pressure to the limb by turning the stick in one direction until it is extremely tight, and then use another piece of cloth or the loose ends of your first knots to anchor it in it's tensed position. Tie another knot, then another to secure the torsion device onto the tourniquet. Do not remove the tourniquet once it is placed. Twist the torsion device in one direction until bleeding stops and secure it in place. **Remember**: it is the screwing and not the knots which make compression. (source *http://www.artofmanliness.com/2012/03/21/how-to-save-lives-like-an-army-medic-using-a-tourniquet-to-control-major-bleeding/*)

Bleeding from head injury

Bleeding from the face can be treated usually by compression, for anything larger than a minor bleed medical treatment is necessary. Bleeding near the eye or from the eye lid can be remedied by the folded triangle bandage and in case of bleeding from the bulb, both eyes must be covered so that you limit movement of the damaged eye (as eyes physiologically move in unison). Because you disorientate the patient and increase his anxiety, you must pay keen attention to reassuring him.

Bleeding from the scalp is usually alarmingly extensive for the size of incision. Do not apply any pressure to a head wound unless you are quite sure there is no possibility of broken skull (see also chapter *11 Peripheral and central nervous system disturbances*). Look for sunken areas, visible bone fragments, or exposed brain tissue. Do not apply pressure to a wound which involves the eye or when an object in the wound clearly pierces the skull. Cover the wound GENTLY with bandages, have the person lie down, and get him medical attention as soon as possible. Keep adding more bandages on top if the dressing gets soaked. Hair makes tape hard to use and even long pieces of cloth wrapped around the head have a tendency to slip so do not waste time trying to secure a regular dressing – focus on quantity of dressing rather than quality. Never wrap anything around the neck.

Picture 13: Head injury (from public source)

Internal bleeding

Internal bleeding cannot be directly observed, one can only look for signs of haemorrhagic shock in case of massive bleeding – see chapter *4.1 Hypovolemic shock*. The exemption is intracranial bleeding. It does not cause haemorrhagic shock in spite of being life threatening – see *chapter 11.2.2.3 Intracranial bleeding*. Internal bleeding must be expected in some types of injury even if signs of haemorrhagic shock are not present, like long bone fractures, chest or abdominal injury. Even a suspicion toward internal bleeding demands medical examination and treatment.

Bleeding from body orifices

It is a combination of external (visible) and internal bleeding.

Video 3: Bleeding on the head

Nosebleed (Epistaxis)

A nosebleed is common in babies and children. The majority of nosebleeds arise from small blood vessels located in the front of the nasal passages that are fragile. Let the person sit down and bend forward. Sitting is preferable to lying down, since keeping the head above the level of the heart will help reduce the bleeding. Bending forward is also important. It lets the blood drain out through the nose rather than down the throat and swallowing, which can increase the risk of vomiting and/or aspiration. Ask the patient (or hold yourself) to pinch the nose just below the ossa nasali on the soft portion of the

nose until the bleeding stops. Pinching sends pressure to the bleeding point on the nasal septum and often stops the flow of blood. Always pinch the soft part of the nose, not the hard bridge. This might take five to ten minutes. Placing an ice pack on the back of the neck can also be helpful. After bleeding stops, advise the person not to clean his nose or sneeze for 30 minutes. If a nosebleed goes on for more than 15 minutes, occurs following a serious injury, or is accompanied by severe blood loss, you should call a doctor or visit the emergency room.

Bleeding from the mouth

Have the person sit up and tilt his or her head forward with the chin down. This will help any blood drain out of the mouth, not down the back of the throat. Swallowing blood can cause vomiting. In case of an injured lip, press firmly on the wound with a clean cloth or the cleanest material available. If there is an object in the wound, apply pressure around the object, not directly over it. Apply steady pressure for a full 15 minutes.

To quell inner lip and inner cheek bleeding, place rolled gauze or a piece of clean cloth between the wound and the teeth and apply pressure for 10 – 15 minutes

For a tongue bleed – squeeze or press the bleeding site with gauze or a piece of clean cloth.

Gum bleeding – try biting down on a piece of gauze for 10 to 15 minutes. Avoid spitting, using any form of tobacco, and using straws, which can make bleeding worse.

If moderate to severe bleeding has not slowed or stopped, continue direct pressure while getting help.

Tooth injury

It's sometimes possible to successfully implant permanent teeth that have been knocked out, but only if it does not dry out. If reimplantation does not occur within two hours after the tooth is knocked out, the likelihood of success becomes poor — so it's vital to get emergency dental care. Handle the tooth by the top or crown only — do not touch the roots and try to put it back in the socket. If you can't put the tooth back in the socket, immediately place it between the cheek and gum. In case of difficult cooperation and/or risk the tooth can be swallowed, put it in some milk, the victim´s saliva or a warm, mild saltwater solution (1/4 teaspoon salt to 1 litre of water). Get emergency dental care.

It is not necessary to reimplant baby teeth (primary teeth) if they're knocked out.

If only a part of tooth is broken and if it is larger than 1/3 of visible crown, bring it to the dentist.

Gastrointestinal tract (GIT) bleeding

Signs of GIT bleeding are such that the patient can vomit blood (in acute bleeds) or dark brown, granular material that resembles coffee grounds in chronic conditions. This results from upper GI bleeding that has slowed or stopped, with conversion of red hemoglobin to brown hematin by gastric acid. Blood or very dark, foul smelling stool (caused by digested blood) called melena is also a sign of upper GI bleeding. In first aid – use antishock treatment, and if necessary you must prevent aspieration of blood.

REMEMBER: every GIT bleeding needs medical examination (see chapter *14 Acute abdomen*). Urgency of examination depends on the state of the patient. In case of major bleeding call the Emergency Medical Services, and in minor bleeding (for instance if the patient notices it in his stool) they can arrange an examination himself. Even minor bleeding should be examined, as it can be the first sign of a malignancy.

Coughing up blood

First aid as in case of GIT bleeding.

Bleeding from reproductive organs

First aid as in case of GIT bleeding.

6. Circulatory disorders of non-traumatic origin

6.1. Chest pain, heart rhythm disturbances

Chest pain is a frequent reason (30 % in the Czech Republic) for prehospital EMS interventions. Any thoracic or abdominal organ can be affected. To assess and diagnose, we have these tools at our disposal:

- Patient History
- Physical examination
- Technical aids for medical professionals (ECG etc.)

Medical history

This is the most important part of examination in first aid for chest pain. It consists of:(source *https://en.wikipedia.org/wiki/Medical_history*)

- Identification and demographics: name, age, height, weight.
- chief complaint "(CC)" – the major health problem or concern, and its time course (e.g. chest pain for past 4 hours).
- History of the present illness (HPI) – details about the complaints, enumerated in the CC.
    - circumstances, when and how problems appeared
    - localisation of pain
    - character of pain
    - duration of pain
    - other symptoms (vomiting, nausea, sweating)
- Past medical history (PMH) (including major illnesses, any previous similar problems, any current ongoing illness, e.g. diabetes).
- Review of systems (ROS) Systematic questioning about different organ systems
- Family diseases – especially those relevant to the patient's chief complaint.
- Childhood diseases – this is very important in pediatrics.
- Social history (medicine) – including occupation, drug use (including tobacco, alcohol, other recreational drug use), recent foreign travel, and exposure to environmental pathogens through recreational activities or pets.
- Regular and recent medications (including those prescribed by doctors, and others obtained over-the-counter or alternative medicine)
- Allergies – to medications, food, latex, and other environmental factors
- Sexual history, obstetric/gynecological history, and so on, if appropriate.

Physical examination

- Visual – facial appearance, chest movements, skin colour etc.
- Auscultation– heart rate, pules irregularities, breath sounds
- Palpation – pain, chest irregularities

Auxiliary methods

ECG, blood pressure, pulse oximetry, capnometry, laboratory examination

6.2. The most common causes

1) Acute ischemic heart disease (myocardial infarction)

- Intense retrosternal pain or retrosternal pressure sensation that also may be characterised as squeezing, aching, burning, or even sharp and often radiates up to the neck, shoulder, and jaw and down to the ulnar aspect of the left arm
- Nausea and/or vomiting
- Cold sweats
- Restlessness
- Influence of stress, weather changes, temperature etc.
- History of previous chronic ischemic heart disease

2) Vertebrogenic pain (pain "from spine")

- Chronic problems with spine
- Long-lasting or cyclic pain (hours, days)
- Localised character (patient can find trigger point to provoke pain)
- Some relief position
- In case of doubts suppose heart attack

3) Pulmonary diseases

- Pain originates in pleura
- Inflammations, tumours
- Signs and symptoms of infection – dyspnoea, fever, cough, exhaustion
- Intensity of pain depends on chest movements
- Pathological lung sounds: wheezing, crackles, pleural rubs
- Sometimes combination of pulmonary and cardiogenic aetiology

4) Ruptured oesophagus

- Gastro-esophageal reflux (GERD)
- History of vomiting

5) Neurasthenia

- Usually localised pain between ribs
- Young people (stress)
- Hyperventilation

6) Posttraumatic pain

- History of trauma
- Can be localised
- Pain during palpation
- Usually worse during inspiration

7) Aortic dissection

- Similar to myocardial infarction
- Sudden severe chest or upper back pain, often described as a tearing, ripping or shearing sensation, that radiates to the neck or down the back. The textbook presentation is between the shoulder blades.
- History of hypertension, ischemic heart disease, age over 55
- Could cause loss of consciousness, shortness of breath, sudden difficulty speaking, loss of vision, weakness or paralysis of one side of your body, similar to those of a stroke, weak pulse in one arm compared with the other etc.

8) Pulmonary embolism

- Dyspnoea, chest pain, tachycardia, tachypnoea, hypoxia, cyanosis
- Dilated neck veins, cardiogenic (obstructive shock)
- History of long immobilisation, dehydratation, cancer, anti-baby pills

9) Tension pneumothorax

- Significant dyspnoea
- Fainting
- Dilated neck veins
- Sometimes subcutaneous air
- Loss of breath sounds and hollow sounds during percussion

6.3. Immediate life-threatening diseases

- Acute coronary syndrome (acute infarction – heart attack, non-stable angina pectoris)
- Dissection of thoracic aorta
- Tension pneumothorax
- Ruptured oesophagus
- Pulmonary embolism

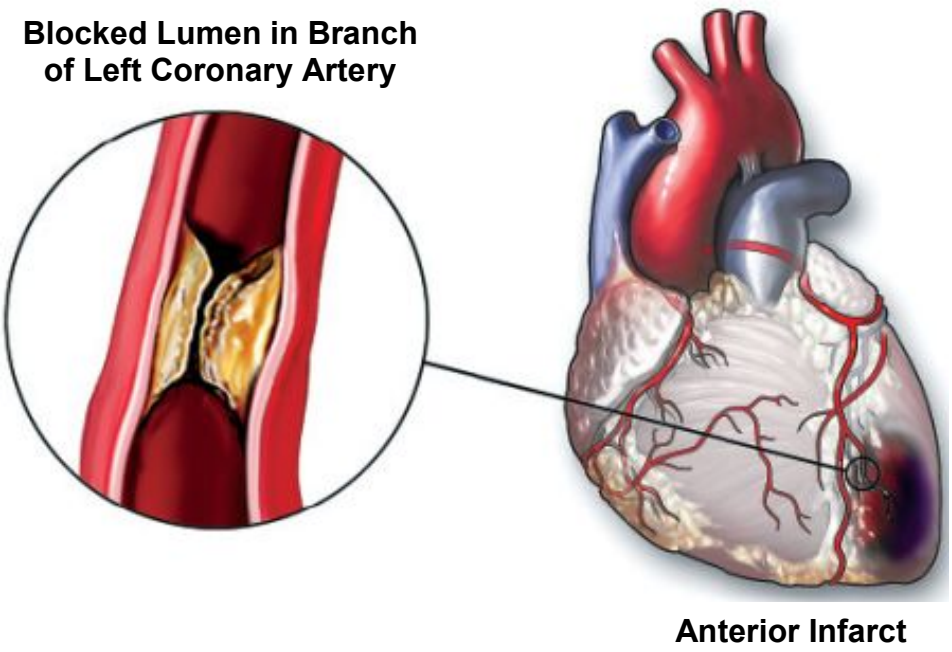
Signs and symptoms of immediate life-threatening diseases (red flags)

- Disturbances of vital functions (tachycardia, bradycardia, tachypnoea, hypotension)
- Signs of low cardiac output (e.g. fainting, confusion, cold sweat, ash-coloured skin)
- Sweating
- Nausea and vomiting
- Asymmetric breath sounds and/or irregular pulse

6.3.1. Acute myocardial infarction – heart attack

Definition: Myocardial Infarction (heart attack) is the irreversible necrosis of heart muscle secondary to prolonged ischemia.

Causes: Usually obstruction of one or more coronary arteries by an atheroma, less frequently by embolus (blood clot, piece of atheroma plaque), arterial spasm, serious systemic hypotension, carbon monoxide intoxication etc.



Picture 14: Myocardial Infarction (from public source)

History:

sudden pain, usually during periods of normal household activity (70%) and at rest (45%) or light exertion (30 %). The patient could already have some preexisting cardiac disease or hypertension.

Signs and symptoms: (source *http://emedicine.medscape.com/article/155919-overview*)

- Fatigue
- Chest discomfort
- Malaise

Typical chest pain in acute myocardial infarction has the following characteristics:

- Intense and unremitting for 20-60 minutes
- Retrosternal and often radiates up to the neck, shoulder, and jaw and down to the ulnar aspect of the left arm
- Usually described as a retrosternal pressure sensation that also may be characterised as squeezing, aching, burning, or even sharp.
- In some patients, the symptom is epigastric, with a feeling of indigestion or of fullness and gas
- Unusual, but still possible is that the patient has no sensation of pain at all – this is most common in long standing diabetes mellitus.

The patient's vital signs may demonstrate the following in myocardial infarction:

- The patient's heart rate is often increased secondary to sympathoadrenal discharge
- The pulse may be irregular
- The respiratory rate may be increased in response to pulmonary congestion or anxiety
- Intensive sweating
- Frequently nausea or vomiting
- Sometimes red flags
- Sometimes intensive fear from death

First aid:

- Call EMS
- Have the person sit down, rest, and try to keep calm.

- Let them chew and swallow ½ an Aspirin
- If the patient does not faint, keep him in any position that is comfortable (usually sitting or semi-sitting).
- Ask if the person takes any chest pain medication, such as nitroglycerin, for a known heart condition, and help them take it.
- Prepare to resuscitate

Further therapy:

Morbidity and mortality from myocardial infarction are significantly reduced if patients and bystanders recognise symptoms early, activate the emergency medical service (EMS) system, and thereby shorten the time to definitive treatment. Trained prehospital personnel can provide life-saving interventions if the patient develops cardiac arrest. The key to improved survival is the availability of early defibrillation.

As a general rule, initial therapy for acute myocardial infarction is directed toward restoration of perfusion as soon as possible to salvage as much of the jeopardised myocardium as possible. This may be accomplished through medical or mechanical means, such as thrombolysis, angioplasty or coronary artery bypass graft surgery.

6.3.2. Chronic ischemic heart disease – angina pectoris

Definition: temporary hypoxia of heart cells without their death.

Causes: Narrowing of coronary artery by atheroma plaque or spasm and increased demand for oxygen in the myocardium

History: chest pain, usually during/after stress, exercise or leaving a warm environment to the cold (such as leaving home during the winter)

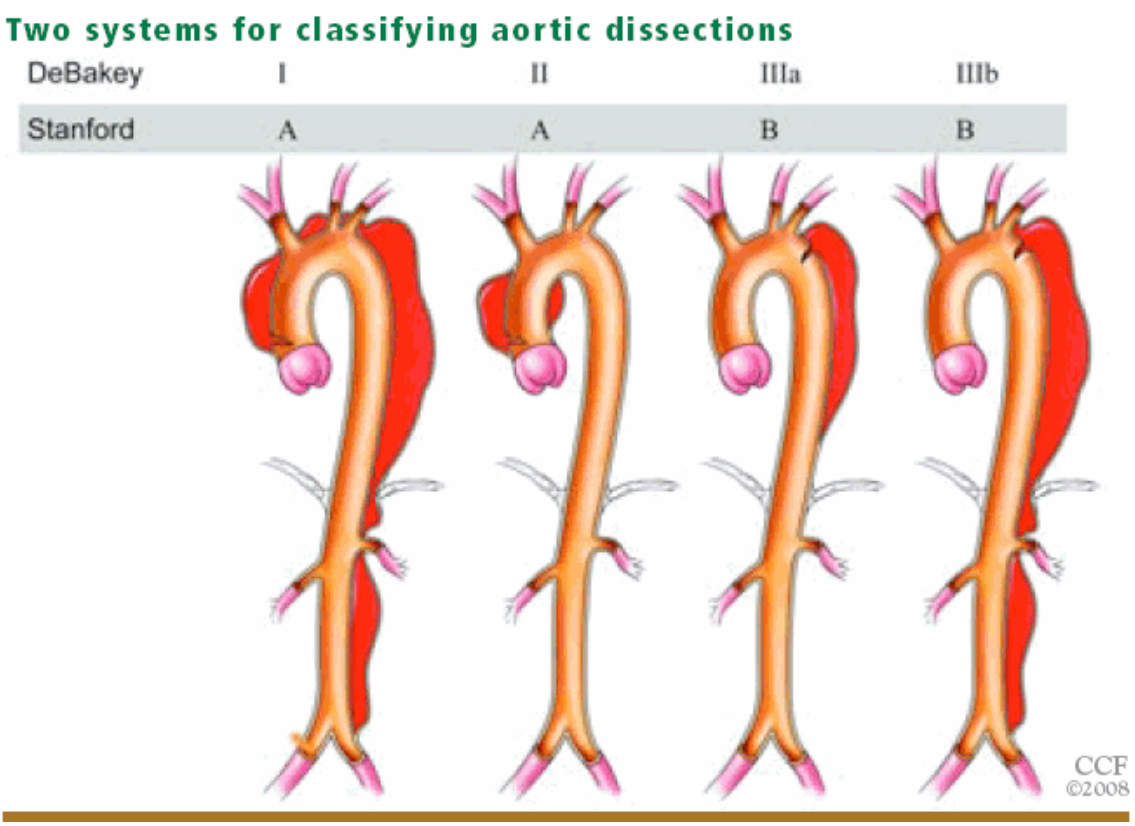
Signs and symptoms: Similar to heart attack, duration is less than 20 minutes, is relieved by rest, nitroglycerine etc. Red flags are absent.

First aid:

- If the patient knows, he has angina and symptoms are relived by prescribed medication or the episode is self limiting, there is no reason to call EMS.
- Help to administer chronic drugs.
- In case of first attack or atypical character, act in accordance with the suspicion of a heart attack.

6.3.3. Dissection of thoracic aorta

Definition: A cavitation of the medial layer of the aortic wall. When the lining of the aorta tears, blood can surge through, separating (dissecting) the middle layer of the wall from the still intact outer layer. As a result, a new, false channel forms in the wall of the aorta and may close other arteries producing manifold symptoms.



Picture 15: Dissection of aorta (source http://decode-medicine.blogspot.cz)

Causes: Usually inherited (in young) or degenerative changes of the inner layer of the aortic wall, less frequently atheroma, trauma

History: High blood pressure, age over 55, atherosclerosis, some genetic diseases (Marfan syndrome, Turner syndrome) and syphilis.

Signs and symptoms: Aortic dissection symptoms may be similar to those of other heart problems, such as a heart attack. Typical signs and symptoms include:

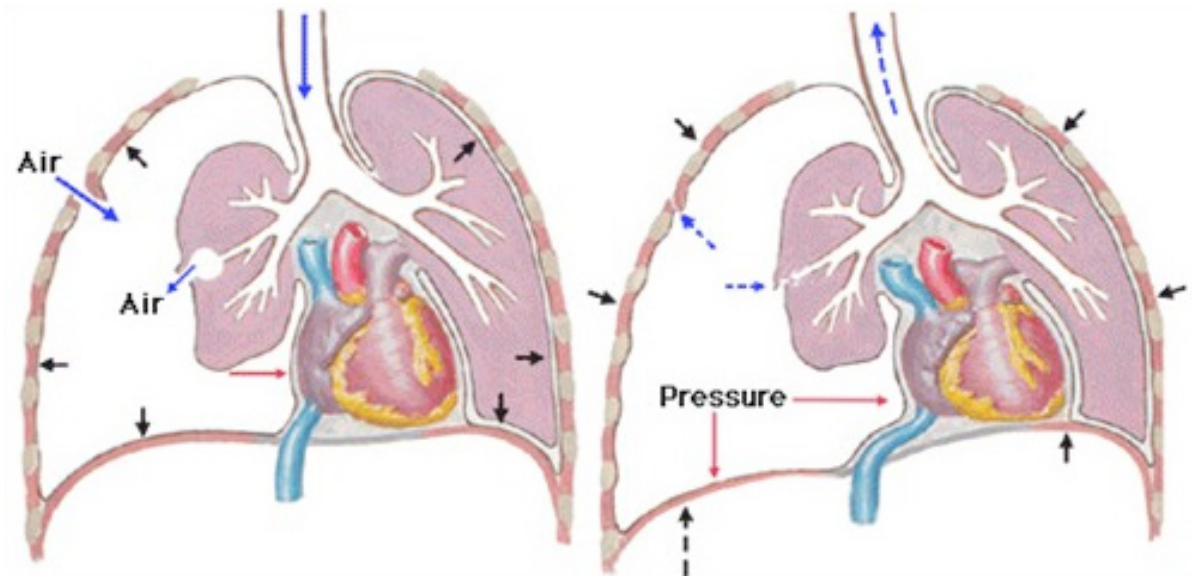
- Sudden severe chest or upper back pain, often described as a tearing, ripping or shearing sensation, that radiates to the neck or down the back
- Loss of consciousness
- Shortness of breath
- Depending on other arteries closure
    - Sudden difficulty speaking, loss of vision, weakness or paralysis of one side of body, similar to those of a stroke
    - Weak pulse in one arm compared with the other

First aid: As in myocardial infarction, but **do not give Aspirin**

Prognosis: uncertain

6.3.4. Tension pneumothorax

See chapter *13.1.1 Pneumothorax*



Picture 16: Tension pneumothorax (public source)

6.3.5. Ruptured oesophagus

Definition: Rupture or tear of oesophagus

Causes: Suddenly increased abdominal pressure, excessive vomiting, trauma, chronic pulmonary hypertension, alcoholism.

History: see causes

Presentation: sudden cruel chest pain during vomiting

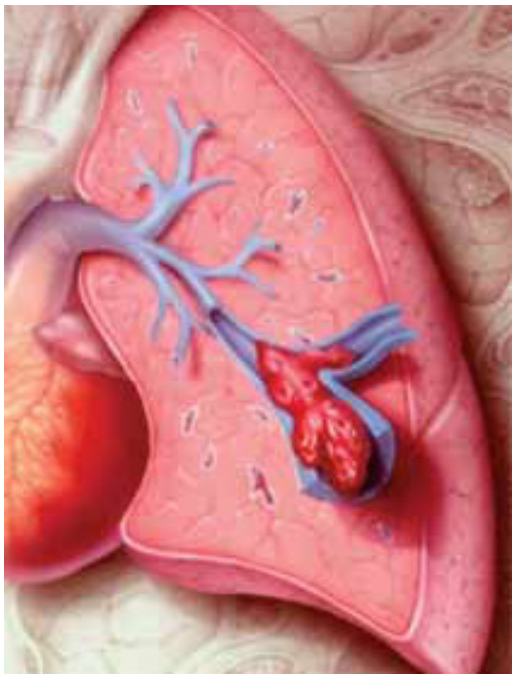
First aid:

- Call EMS
- Nothing to eat or drink
- Relief position

Prognosis: uncertai

6.3.6. Pulmonary embolism

Definition: Closure (obstruction) of the branch(es) of the pulmonary artery by embolus



Picture 17: Pulmonary embolism (from public source)

Causes: Usually part of clotted blood (thrombus), released from the deep veins of lower extremities or pelvic venous plexus. Causes of thrombus could be ulcer of a venous wall, inflammation, increased blood clotting (inherited eg. thrombophlia, or acquired eg. use of by contraceptive pills or cancer), decreased velocity of blood flow or blood stasis (pregnancy, cardiac insufficiency, immobilisation by splint, after surgery, long haul flight, extended bed rest etc.) Less common cause is fat emboli after long bone fractures.

History: presence of risk factors (see above)

Signs and symptoms: Differ according to the extent of embolus. Complete closure of the pulmonary artery is fatal. Massive pulmonary embolism (net closure of 50 % of pulmonary arterial) presents as acute cardiac failure. Patients have severe dyspnoea and chest pain. Medium size embolism affects usually one middle-size branch of pulmonary artery and presents with dyspnoea and chest pain, sometimes with coughing out blood. Closed part of lungs is vulnerable to infection and pneumonia may occurr. Successive small emboli may present with exhaustion, tiredness, and oedemas of lower extremities.

First aid: As in myocardial infarction

6.4. Orthostatic collapse (fainting)

Definition: Syncope (fainting) is a short loss of consciousness and muscle strength, characterised by a fast onset, short duration, and spontaneous recovery.

Causes: decrease in blood flow to the brain usually from low blood pressure. Vasovagal (situational) syncope is one of the most common types which may occur in response to any of a variety of triggers, such as scary, embarrassing or uneasy situations, during blood drawing, or moments of sudden unusually high stress. Orthostatic (postural) hypotensive faints are as common or perhaps even more common than vasovagal syncope. Orthostatic faints are most often associated with movement from lying or sitting to a standing position, standing up too quickly, or being in a very hot room. Other causes are fasting, exercise, abdominal straining, or circumstances promoting vasodilation (e.g., heat, alcohol, antihypertensive medications)

Prodromal symptoms: Some people have prodromal symptoms before loss of consciousness occurs. These symptoms may include light headedness, sweating, pale skin, blurred vision, nausea, vomiting, and feeling warm, among others. Syncope may also be associated with a short episode of muscle twitching.

Signs and symptoms: Short loss of consciousness and muscle strength, characterised by a fast onset, short duration, and spontaneous recovery. Many people may report symptoms of syncope, but to determine true loss of consciousness, a prudent question in anamnesis would be: "do you remember hitting the ground when you fell?"

First aid:

- During prodromal symptoms – positioning the person on the ground, with legs slightly elevated or leaning forward and the head between the knees for at least 10–15 minutes, preferably in a cool and quiet place.
- After fall – antishock position, check vital functions, apply a cold wrap to the forehead
- After the symptoms have passed, rest and recommend the patient to have a drink of water.
- If fainting spells occur often without a triggering event, syncope may be a sign of an underlying heart disease and needs medical examination.
- If unconsciousness continues – put a patient to stabilised position and treat as other unconsciousness
    - Call EMS if a victim remains unconscious, if he has other problems like difficulty speaking, loss of vision, weakness or paralysis of one side of body, headache, convulsions etc.

6.5. Non-traumatic bleeding

Causes: Overdosing of some drugs (Warfarin), bacterial toxins (Meningococcus), rarely inherited disease (haemophilia), haematological diseases or ruptured vessels by tumours, ulcers, ectopic pregnancy etc.

History: Presence of above mentioned causes

Signs and symptoms: bleeding of skin, mucosa, signs of sepsis (see chapter *4.3 Septic shock*) meningeal irritation (see chapter *11.7 CNS infections*). In case of abdominal bleeding signs of shock or acute abdomen – (see chapter *14 Acute abdomen*)

First aid: call EMS, in case of acute abdomen – (see chapter *14 Acute abdomen*)

7. Bone and joint injury

7.1. Fractures

Definition: A fracture is a broken bone. Open fracture means that there is the skin is also broken to some extent: from minor bruising to penetration of bone through the surface. Fractures also result in bleeding, which could range from minor to severe (in case of fractured femur one can often note 2 litres of blood loss). There is also probable damage to nerve and soft tissue injury

Causes: Excessive pressure, pulling or rotation exceeding limits of bone flexibility. Additional factors may be pathological conditions like osteoporosis or tumour. Special case are fatigue fractures from cyclic overloading, like marching, running, ballet, gymnastics

History: Injury or excessive strain in the injured part of body

Picture 18: Open fracture (from public source)

Signs and symptoms: Pain that increases with movement, loss of function, loss of shape (shortening, distortion), pathological movement, oedema, hematoma. On movement, crepitation could be heard, but this type of examination is definitely not recommended. Skin wound in case of open fracture, it is quite rare that the bone can be seen through the skin.

Risks:

- Bleeding (in case of closed fracture of femur, blood loss can be up to 2 l, in case of fractured pelvis can a victim bleed to death
- nerve injury (typically radial nerve in case of fractured humerus)
- fat embolism
- infection

First aid:

In first aid the most important consideration is safety of the rescuer. Don't treat anyone if you're in harm's way. You should consider: did your patient broke their leg from a fall? If so, are you in a position to fall yourself? If you're at risk, address your safety first, and then care for the patient.

In case of major trauma, use an acronym called MARCH (*http://www.artofmanliness.com/2012/11/29/save-lives-like-a-combat-medic-how-to-splint-a-lower-leg-fracture/*)

- Major Hemorrhage
- Airway
- Respirations
- Circulation
- Head Injuries, Minor Hemorrhaging, Hypothermia/Shock

Expose the injury. In major trauma, do NOT focus only on the visible injuries — there could be other injuries you're not seeing because they're masked by clothing.

Manually stabilise the fracture before splinting if possible. If you aren't alone with the patient, have someone hold the broken limb in place.

Apply a splint. Closed fractures of long bones require a splint "over two joints". In open fractures clean and disinfect margins of the wound, cover with sterile dressing and immobilise. Never apply pressure or remove pieces of bone. In case of major bleeding use tourniquet.

Do not give anything to eat or drink. Use your own transport in case of minor bone fractures or call EMS.

Immobilisation of specific bones – *see videos from page 41*

7.1.1. Broken fingers

Mechanism, history and signs – see common part

First aid:

- Treat patients when they are in a seated position.
- Let a patient hold some soft tissue in the palm of the hand
- Fix whole hand with a bandage or use uninjured fingers as a splint
- Use your own transport to the accident and emergency clinic

Picture 19: Open fracture of a finger (from public source)

7.1.2. Broken hand, wrist and forearm

Mechanism, history and signs – see above

First aid:

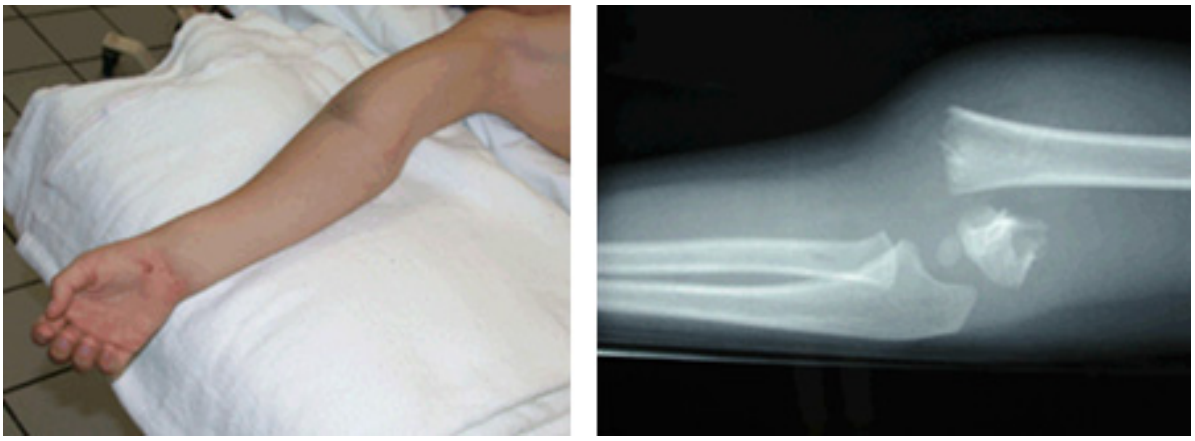
- Treat in a sitting position.
- Put some soft padding to the palm
- Use a splint from elbow to fingers
- Fix forearm with triangular bandage around the neck. In case of oedema, elevate the hand. Use an ice pack or wrap the ice in a clean cloth. Do not place ice directly against the skin.
- You may use your own transport to surgery

Picture 20: Fracture of forearm and Colles fracture (from public source)

Picture 21: Fracture of hand (from public source)

Video 4: Immobilisation of a hand and a forearm

7.1.3. Broken humerus (arm)



Picture 22: Fracture of humerus (from public source)

Video 5: Immoblisation of an arm

Mechanism, history and signs – see above

First aid:

- check below the fracture for pulse, motor and sensory capacity (signs of radial nerve and/or brachial artery injury)
- Treat in a sitting position.
- Use a splint and triangle bandage as in broken forearm
- Fix the arm with another bandage to the trunk
- Call EMS. Seeing as this is a more severe break, transport to the hospital by your own means is not recommended.

7.1.4. Broken clavicle

Mechanism: usually indirect force during fall on extended upper extremity

History and signs – see above

First aid:

- Treat in a sitting position.
- Use a splint and triangle bandage as in broken forearm with elevated hand (the hand on injured side touches the opposite shoulder)
- You may use your own transport to the A&E department.

Picture 23: Fracture of clavicle (from public source)

7.1.5. Broken foot and ankle

Mechanism, history and signs – see above

First aid:

- check below the fracture for pulse, motor control and sensory capacity
- Treat in a sitting position or supine position with elevated calf
- Use an ice pack or wrap the ice in a clean cloth. Do not place ice directly against the skin.
- Compress by wrapping ankle lightly (not tightly) with an "U" bandage or elastic ankle brace. Do not try to align the bones.
- Elevate ankle above the level of the heart to minimise blood loss, or stagnation in the immobilised extremity.
- Call an ambulance.

Picture 24: Fracture of ankle and open fracture of shank (from public source)

Video 6: Immoblisation of a leg and an ankle

7.1.6. Broken Shin (Tibia and/or Fibula)

Mechanism, history and signs – see above

First aid:

- Treat in a supine position

- Use an uninjured lower extremity as a splint and fix both extremities together in ankles, knees and thighs with padding between joints. This will be disconcerting for the patient, so if he is still conscious make best efforts to reassure him.
- Apply anti –shock preventive measures
- Call EMS

Picture 25: Fracture of shank(from public source)

Video 7: Immobilisation of a femur and a pelvis

7.1.7. Broken femur

Mechanism, history and signs:

For the most part you can again apply the information above, but in case of a fracture to the neck of the femur, the mechanism and external signs may be less obvious. These such fractures are mainly observed in old people with osteoporosis. These kind of fractures can result even after minor injury. The main signs and symptoms are pain on movement and difficulties to bear weight on the injured extremity.

First aid:

- As in a fracture of the shin
- Note that this (along with a broken pelvis) is a common injury incurred in motorcycle accidents, and the tell tale sign of this is weather or not the rider has a boot missing. The only way for a motorcycle boot to be pulled off during a collision is the outward rotation of the foot incurred by a broken femur. In this case, pay extreme care not to let the patient stand under any circumstance – It is a common reaction for bikers to want to 'walk it off' while still under the influence of the stress response, and a mistake seen all too often at racing events.
- See the *Video 7: Immobilisation of a femur and a pelvis*

Picture 26: Fractures of neck of femur and femur (from public source)

7.1.8. Broken pelvis

Mechanism, history and signs:

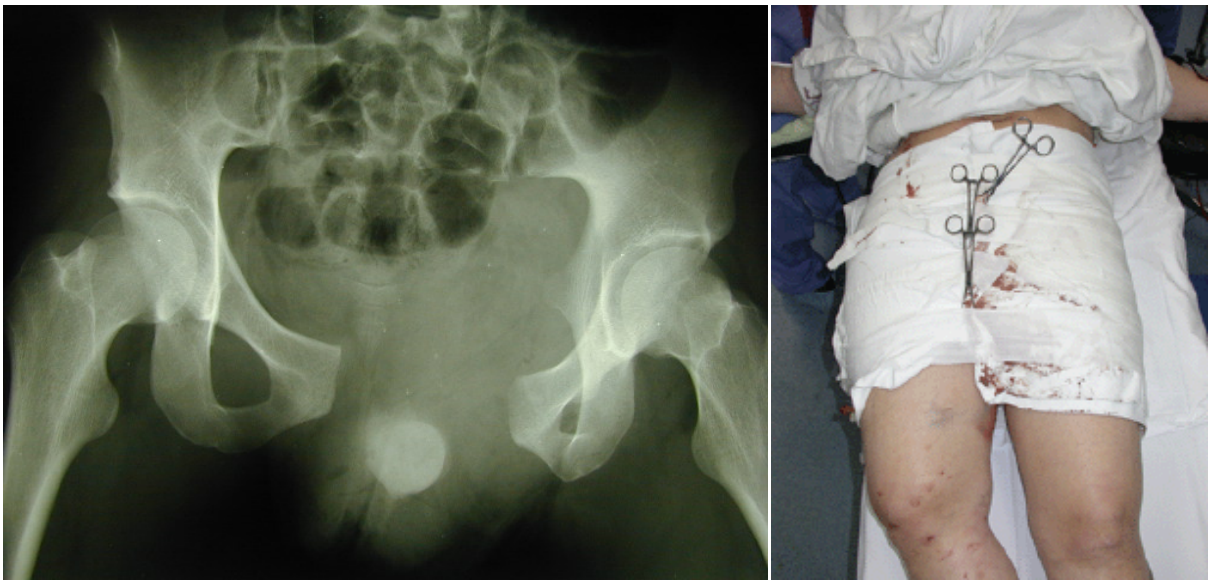
Significant force to the pelvic area (falls, car accidents), frequently with other injuries, signs and symptoms of haemorrhagic shock because of massive internal bleeding which is typical for this type of injury.

First aid (source *http://www.realfirstaid.co.uk/pelvic-sling/*):

- Because an injury to the pelvis can also involve injury to the lower spine, it is best not to move the person. If possible, try to keep the person lying flat. Avoid excessive manipulation – you may worsen internal bleeding
- Using a triangular bandage or alternative (tape, cord, belt etc) tie the casualty's ankles together; this is most comfortably and stably achieved applying a 'figure of eight' around the back of the casualty's ankles, across their shoe laces and tied off underneath their feet.
- Tying the ankles together bring in the feet which prevents outwards rotational forces on the pelvis.
- Completely unfold a space blanket and while grasping the top edge with hands wide apart, gather up the entire blanket into pleats into your hands.
- Pass the gathered space blanket under the natural hollows behind the casualty's knees to minimise movement. Pull the blanket through until it is central.
- Have an assistant stand astride of the casualty, above their waist and lift the casualty's bottom off the ground (only an inch or so) by grabbing them by their belt or waist band. If they are

wearing tracksuit trousers or something stretchy without a stable belt, have them reach under their bottom and lift them up by pulling the seat of their trousers taut.

- Quickly, slide the blanket under their bottom and unfurl the pleats so that the blanket is spread out from their waist down to the crease between their buttocks and the top of their thighs.
- Gently lower the casualty only the blanket.
- Bring either side of the blanket around the casualty's hips, bring the ends together and start twisting to 'wind in' the blanket. This will bring the hips in and stabilise the pelvis without applying direct pressure to the pelvis itself.
- Twist the ends until it feels snug; it must be tight enough to feel as though it is doing something but not so tight that you are 'crushing' the pelvis. Remember, you want to stabilise, not compress!
- Call EMS
- See the *Video 7: Immobilisation of a femur and a pelvis*



Picture 27: Fracture of pelvis (from public source)

7.1.9. Broken maxilla

Mechanism, history – see above.

Signs and symptoms pain, problems on biting, double vision in case of broken lower part of orbit. Being associated with trauma to the head, it frequently comes with other injuries.

First aid:

- fixation of maxilla by a stick applied to upper teeth. Fixation of the head is no more recommended.
- form of transport depends on general heath state of the patient. Usually EMS is called.

Picture 28: Fracture of maxilla (from public source)

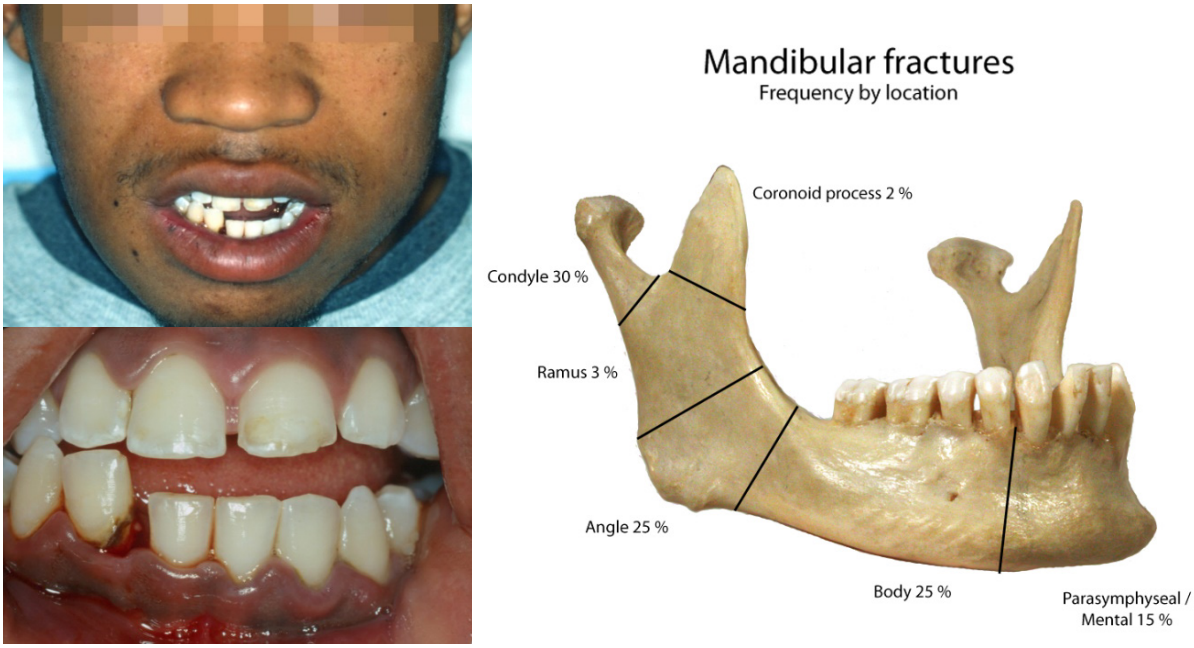
7.1.10. Broken mandible (lower jaw)

Mechanism, history – see above.

Signs and symptoms pain, problems on biting

First aid:

- treat the patient in a sitting position
- fix the jaw by sling "Y" bandage
- form of transport depends on general heath state of the patient. Usually EMS is called.



Picture 29: Fracture of mandible (from public source)

7.1.11. Broken ribs

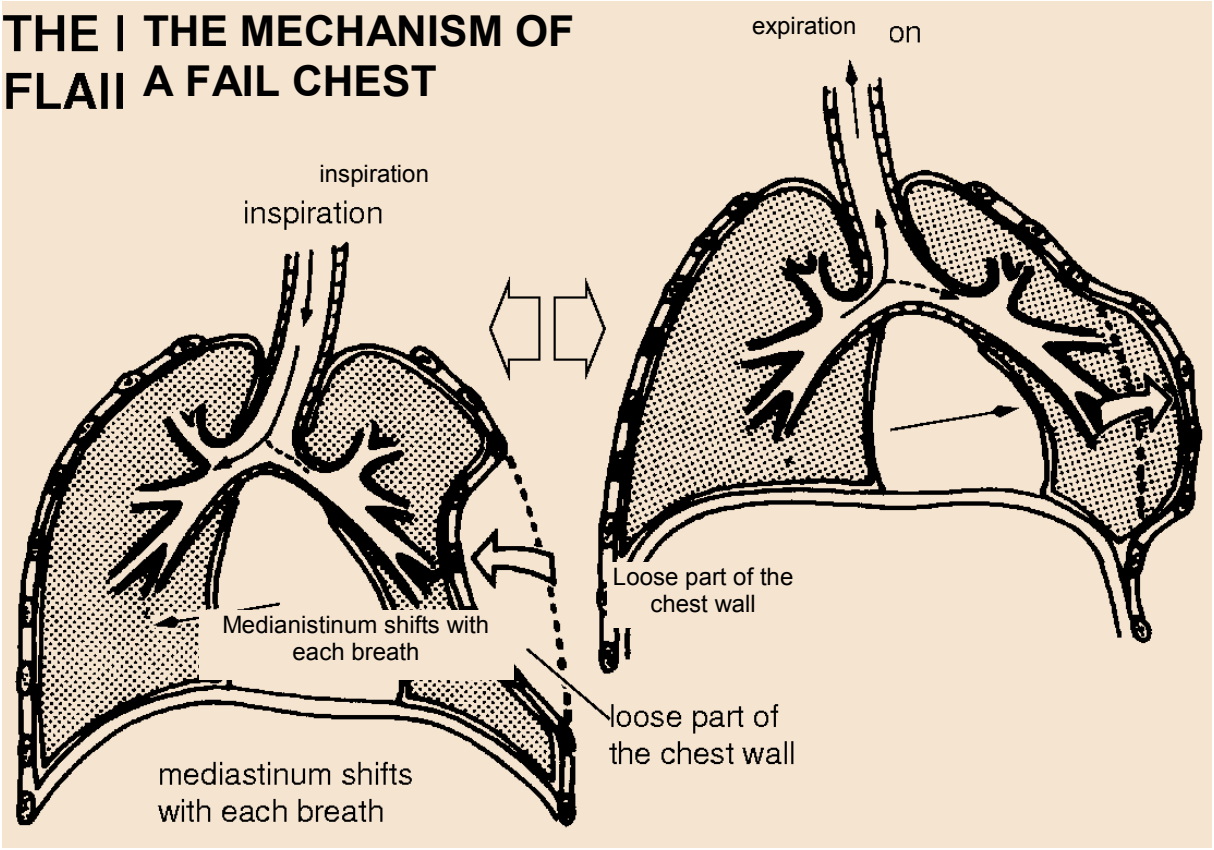
Picture 30: Fracture of ribs (from public source)

Mechanism, history – see common part.

Signs and symptoms pain mainly during breathing. Haematoma. Check signs of pneumothorax and block fracture of ribs or flail chest *Picture 31* (see chapter *13.1 Loss of mechanical function of chest, Video 24: Pneumotorax – first aid, Video 25: Block fractures of ribs, Video 26: Flail chest*),

First aid:

- treatment in sitting or half-sitting position
- apply elastic bandage or any firm bandage (e.g. by adhesive plaster) during maximum expiration
- artificial ventilation or CPR in case of necessity
- call EMS



Picture 31: Flail chest (source **http://www.medicalzone.net)**

7.1.12. Broken skull

See chapter *11.2. Skull and brain injury*

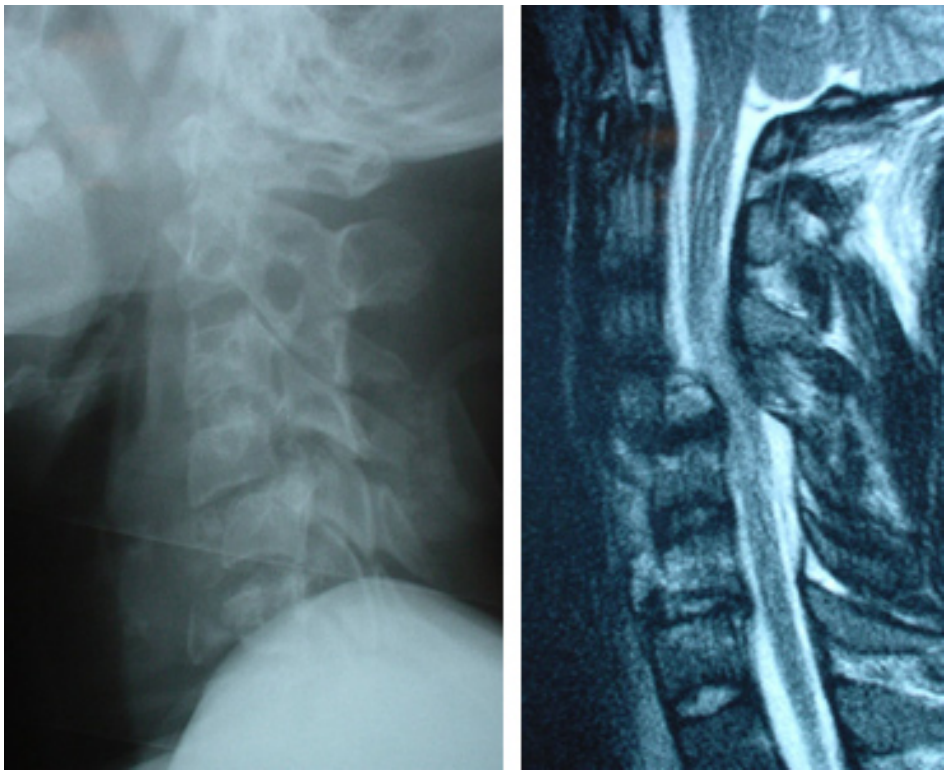
7.1.13. Broken vertebrae

Mechanism and history: usually falls, or injuries with rapid acceleration or deceleration

Signs and symptoms: If conscious, patient complains about back or neck pain, during gentle palpation a deformity in spinal processes can be felt. In an unconscious patient we suspect spinal injury from the mechanism of injury. We check for signs in spinal cord injury (see chapter *11.3 Spine and spinal cord injury*)

First aid:

- If you suspect a back or neck spinal injury, do not move the affected person unless absolutely necessary. Use the Rautek manoeuvre or transport with several people. The spinal column must be kept aligned, flexion, extension or rotation must be avoided to prevent movement of fractured bones and until intact spinal cord injury. (*Picture 32*).
- Place heavy towels on both sides of the neck, fix the head with adhesive plasters to the underlay or hold the head and neck to prevent movement.
- Provide as much first aid as possible without moving the person's head or neck.
- If the person shows no signs of circulation (breathing, coughing or movement), begin CPR, but do not tilt the head back to open the airway. Use your fingers to gently grasp the jaw and lift it forward. If the person has no pulse, begin chest compressions.
- If the person is wearing a helmet, don't remove it, unless necessary (see chapter *11.3*).



Picture 32: Fracture of vertebrae with spinal cord injury (from public source)

7.2. Joint injury

7.2.1. Distorsion (sprain)

Definition: Distortion arises when stress is put upon a joint. The capsule and ligaments may be broken, but there is no fracture of the bone.

Causes: trauma

Signs and symptoms: pain, oedema, limited movement in the joint, haematoma,

First aid:

- depends on extent of injury, usually basic first aid is sufficient
- rest the injured limb, a splint or brace may also be helpful initially
- cooling – use a cold pack, a slush bath or a compression sleeve filled with cold water to help limit swelling after an injury. Try to ice the area as soon as possible after the injury and continue to ice it for 15 to 20 minutes, four to eight times a day, for the first 48 hours or until swelling improves. If you use ice, be careful not to use it too long, as this could cause tissue damage. Never put ice directly against the skin or it may damage the skin. Use a thin cloth for protection.
- compress the area with an elastic wrap or bandage.
- elevate the injured limb above your heart whenever possible to help prevent or limit swelling
- check below the joint for pulse, motor control and sensory feeling
- refer to a doctor if a patient is unable to bear weight on the injured leg, the joint feels unstable or numb, or he can't use the joint.

7.2.2. Luxation (dislocation)

Luxation (dislocation) is displacement of a bone from a joint. A distinction is made between those resulting from accidents (traumatic luxation, very common) or constitutional ones caused by weak ligaments (habitual luxation, rare, usually shoulder or mandible). Frequent habitual luxation is sometimes treated by patients themselves, but this method should be discouraged for the first aid provider. Habitual luxation of hip presents a special problem and does not fit into this category. In trauma, the most common ones involve shoulder, finger, thumb, less common are those of mandible, elbow, or knee. Symptoms include loss of motion, temporary paralysis of the joint, pain, swelling, and sometimes shock. Dislocations are usually caused by a blow or fall, although unusual physical effort may also cause one.

Signs and symptoms:

- Accompanied by numbness or tingling at the joint or beyond it
- Intensely painful, especially if you try to use the joint or put weight on it
- Limited in movement
- Swollen or bruised
- Visibly out of place, discoloured, or misshapen
- Open luxation – skin wound, bleeding, shock in major joints

Picture 33: Luxation of right shoulder joint (from public source)

First aid:

- Call EMS before you begin treating someone who may have a dislocation of a large joint, especially if the accident that caused the injury may be life-threatening. Patients with dislocations of fingers and other small joints may be transported by a car.
- If the person has a serious injury, check their airway, breathing, and circulation. If necessary, begin rescue breathing, CPR, or bleeding control.
- Do not move the person if you think that their head or back have been injured. Keep the person still. Provide reassurance.
- Splint or sling the injured joint in the position in which you found it. Do not move the joint. Also immobilise the area above and below the injured area.

- Check the person's blood circulation around the injury by pressing firmly on the skin in the affected area. It should turn white, then regain colour within a couple of seconds after you stop pressing on it. To reduce the risk of infection, do not do this step if the skin is broken.
- Apply ice packs to ease pain and swelling, but do not put ice directly on the skin. Wrap the ice in a clean cloth.
- Take steps to prevent shock. Unless there is a head, leg, or back injury, lay the victim flat, elevate their feet about 12 inches, and cover the person with a coat or blanket.
- Do not
    - move the person unless the injury has been completely immobilised.
    - move a person with an injured hip, pelvis, or upper leg unless it is absolutely necessary. If you are the only rescuer and the person must be moved, drag them by their clothing
    - attempt to straighten a misshapen bone or joint or try to change its position
    - test a misshapen bone or joint for loss of function.
    - give the person anything by mouth.

7.2.3. Open joint injury

- call EMS
- treat for shock, if present (mainly in large joints)
- take steps to prevent infection. you can observe the injury, but do not attempt probe or meddle with it.
- cover the area with sterile dressings before immobilising the injured joint
- continue as in closed injury

8. Soft tissues injuries

8.1. Classification

Wounds can be classified according to various criteria (source *https://en.wikipedia.org/wiki/Wound*)

According to depths a wound can be classified as

- Superficial (loss of epidermis only)
- Partial thickness (involve the epidermis and dermis)
- Full thickness (involve the dermis, subcutaneous fat and sometimes bone)

According to level of contamination a wound can be classified as

- clean wound, a wound made under sterile conditions where there are no organisms present in the wound and the wound is likely to heal without complications.
- contaminated wound, where the wound is as a result of accidental injury where there are pathogenic organisms and foreign bodies in the wound.
- infected wound, where the wound has pathogenic organisms present and multiplying showing clinical signs of infection, where it looks yellow, oozing pus, having pain and redness.
- colonized wound, where the wound is a chronic one and there are a number of organisms present and very difficult to heal as in a bedsore.

According to mechanism of injury wounds can be classified to

- Open wounds
- Closed wounds

Open wounds can be classified according to the object that caused the wound. The types of open wound are:

- Incisions or incised wounds, caused by a clean, sharpedged object such as a knife, razor, or glass splinter.
- Lacerations, irregular tear-like wounds caused by some blunt trauma. Lacerations and incisions may appear linear (regular) or stellate (irregular). The term laceration is commonly misused in reference to incisions.
- Abrasions (grazes), superficial wounds in which the topmost layer of theskin (the epidermis) is scraped off. Abrasions are often caused by a sliding fall onto a rough surface.
- Avulsions, injuries in which a body structure is forcibly detached from its normal point of insertion. A type of amputation where the extremity is pulled off rather than cut off.
- Puncture wounds, caused by an object puncturing the skin, such as a splinter, nail or needle.
- Penetration wounds, caused by an object such as a knife entering and coming out from the skin.
- Gunshot wounds, caused by a bullet or similar projectile driving into or through the body. There may be two wounds, one at the site of entry and one at the site of exit, generally referred to as a "through-and-through."

Closed wounds have fewer categories, but are just as dangerous as open wounds. The types of closed wounds are:

- Hematomas, also called a blood tumor, caused by damage to a blood vessel that in turn causes blood to collect under the skin.
    - Hematomas that originate from internal blood vessel pathology are petechiae, purpura, and ecchymosis. The different classifications are based on size.
    - Hematomas that originate from an external source of trauma are contusions, also commonly called bruises.
- Crush injury, caused by a great or extreme amount of force applied over a long period of time.

8.2. First aid general

First aid differs according to the type of wound. All extensive wounds and wounds contaminated or infected must be treated surgicaly. Apply the rules for treatment of bleeding (see chapters *5 Bleeding, 4.1 Hypovolemic shock, 10 Positioning and transport*). Check for signs of injuries of tendons (loss of movement, nerve injuries (loss of movement and sensation) that must be treated by a surgeon.

Minor injuries (*http://www.mayoclinic.org/first-aid/first-aid-cuts/basics/art-20056711*)

- Stop the bleeding. Minor cuts and scrapes usually stop bleeding on their own. If not, apply gentle pressure with a sterile bandage or clean cloth and elevate the wound.
- Clean the wound. Use clear water to rinse the wound. Also clean around the wound with soap and a washcloth. Keep soap out of the wound, as it can cause irritation. If dirt or debris remains in the wound after washing, use tweezers cleaned with alcohol to remove the particles. If debris still remains, see a doctor. Thorough cleaning reduces the risk of infection and tetanus. There's no need to use hydrogen peroxide, iodine or an iodine-containing cleanser, which can be irritating to tissue already injured.
- Apply an antiseptic round the borders of the wound, not directly to it
- Cover the wound. Bandages can help keep the wound clean and keep harmful bacteria out. If the injury is just a minor scrape, or scratch, leave it uncovered.

- Change the dressing. Do this at least once a day or whenever the bandage becomes wet or dirty. If the injured person is allergic to the adhesive in tapes and bandages, switch to adhesive-free dressings or sterile gauze held in place with paper tape, rolled gauze or a loosely applied elastic bandage. These supplies generally are available at pharmacies. After the wound has healed enough to make infection unlikely, you can leave it uncovered, as exposure to the air will speed healing.
- Advise a victim to watch for signs of infection. Send him to a doctor if the wound isn't healing or you notice any signs of pyogenic infection: redness, increasing pain, drainage, warmth or swelling.
- Ask for the last tetanus vaccination. If the injured person hasn't had a tetanus shot in the past two years and the wound is deep or dirty, he or she may need a booster shot, as soon as possible.
- Refer to a doctor in case of deep and/or extensive wound, contaminated wound, signs of infection etc.

8.3. Amputation of peripheral part of extremity

Usually amputation of finger or hand – most commonly as a result of home improvement and amateur automotive repair activities

First aid:

- stop bleeding from the stump (use pressure and elevation, tourniquet is less convenient)
- save any severed body parts and make sure they stay with the person. Remove any dirty material that can contaminate the wound, if possible. Gently rinse the body part if the cut end is dirty.
- wrap the severed part in a clean, damp cloth, place it in a sealed plastic bag and place this bag in a second bag with an ice water bath (2 parts water to 1 part ice).
- do not directly put the body part in water without using a plastic bag or put the severed part directly on ice or use dry ice as this will cause frostbite and injury to the part. The body part must not get frozen!
- do not apply disinfection of peroxide directly on the stump
- do not disrupt any pieces of skin connecting the stump and the amputated part
- if cold water is not available, keep the part away from heat as much as possible. Save it for the medical team, or take it to the hospital. Cooling the severed part will keep it safe for reattachment for about 18 hours. Without cooling, it will only remain safe for about 4 to 6 hours.
- call EMS.
- keep the person warm.
- once the bleeding is under control, check the person for other signs of injury that require emergency treatment. Treat fractures, additional cuts, and other injuries appropriately.
- stay with the person until medical help arrives.

Picture 34: Finger amputation (source http://charmssingapore.com)

Picture 35: Subtotal hand amutation (source http://www.trauma.org)

8.4. Human or animal bite

Epidemiology: children younger than 17 years are victims in 42 % (most commonly 5 – 9 years). Most frequent localisation is: upper extremity 45.3 %, lower extremity 25.8 %, head and neck 22.8 % (<4 years 64.9 %).

Mechanism of injury

- dogs – contusion and tearing of tissues
- cats – deep, puncture like injury
- rats – small puncture injury
    - Note that Bat bites are frequently omitted from references, but produce a similar picture to a rodent's bite.

Risks:

- bleeding
- infection
    - pyogenic
    - rabies
- mutilation
- psychic problems (phobia)

First aid

- Examination
- Stop Bleeding
- Clean and Protect. Washing with soap and disinfection helps to prevent infection.
- Apply sterile dressing and immobilise.
- Seek medical help immediately for any animal bite that is more than a superficial scratch or if the animal was a wild animal or stray, regardless of the severity of the injury. Tetanus and other infection prophylaxis are necessary.
- If the animal's owner is available, find out if the animal's rabies shots are up-to-date. Give this information to the health care provider. In the Czech Republic, rabies was supposed to be eradicated in 2004. If it is safe to do so, keep the offending animal contained so that it may be examined for disease. In some countries this extends one the right to exterminate it.
- Refer to a doctor; mode of transport depends on the extent of injury

8.5. Snake bite

The only venomous snake in the Czech Republic is common viper (Vipera berus); it’s toxin is usually not deadly to humans

Early signs: pain, oedema within minutes, swelling and pain of regional lymphatic nodes, vomiting as early as 5 minutes of bite and lasting up to 48 hours, swelling of face, lips, sweating, abdominal pain, diarrhoea, shock

Late signs: swelling of extremity for 48-72 hours, sometimes blisters, hypotension, shock, bleeding disorders

First aid:

- Call EMS
- Have the person lie down with wound below the heart.
- Keep the person still to keep venom from spreading.
- Cover the wound with loose, sterile bandage.

Not recommended:

- Cutting a bite wound
- Attempt to suck out venom
- Apply tourniquet, ice, or water
- Give the person alcohol or caffeinated drinks

8.6. Insect bites

Insect bites brings **3 risks**

- Allergic reaction (see chapter *17.1.4 Allergic oedema of upper* airways)
- Toxic reaction (Hymenoptera – bee sting, wasp or hornet)
- Transmission of infection (e.g. mosquito)

First aid:

minor reaction:

- If needed, remove the stinger (do not squeeze venom sac of bee).
- Wash the area with soap and water.
- Apply a cool compress. Use a cloth dampened with cold water or wrapped around ice. This helps reduce pain and swelling. If the injury is on an arm or leg, elevate it.
- Apply a soothing cream, gel or lotion to the injured area (e.g. Fenistil gel).

major reaction:

- call EMS immediately
- in oedema of airways, let the patient suck ice and apply an ice pack to the neck
- help to apply EpiPen if available (see *Video 31: How to use EpiPen*). Always call EMS, even after the EpiPen relives symptoms of anaphylaxis. An allergic reaction may return after several hours, therefore medical treatment and usually 24 hour hospitalisation is necessary.

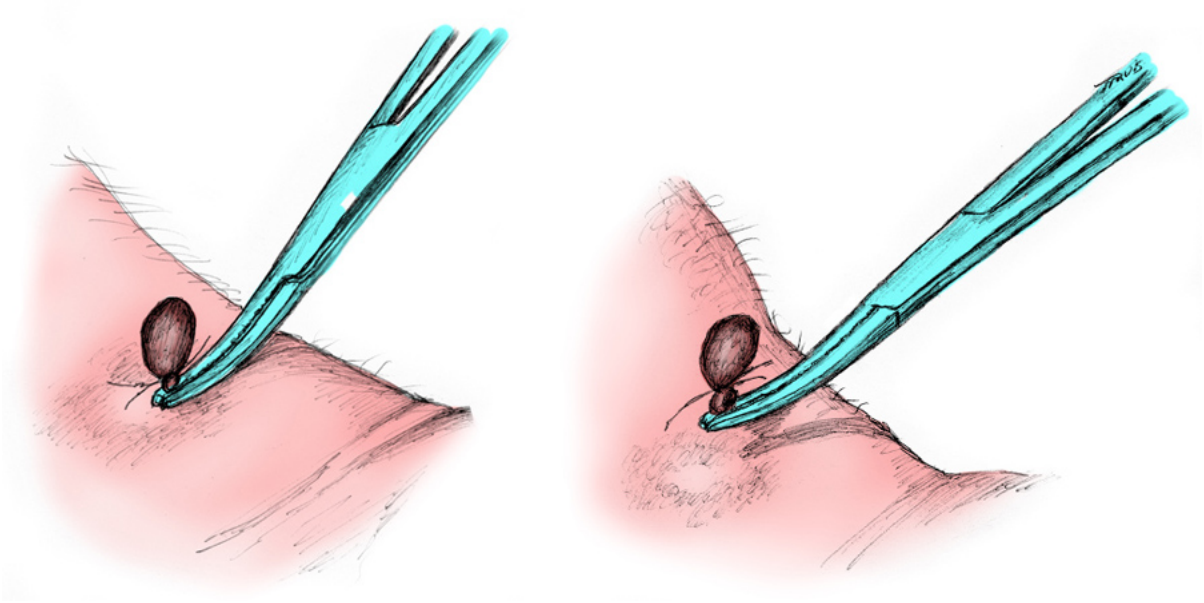
8.7. Tick bite

Most tick bites cause only minor injury. But some ticks may transmit bacteria that cause illnesses, such as Lyme disease or meningoencephalitis. Symptoms of illness may appear after substantial time, so it is good to remember date of tick bite for further medical history and examination

First aid:

- Use fine tipped tweezers to remove a tick. If you don't have tweezers, put on gloves or cover your hands with tissue paper, then use your fingers. Do not handle the tick with bare hands.
- Grab the tick as close to its mouth (the part that is stuck in your skin) as you can. Do not grab the tick around its swollen belly. You could push infected fluid from the tick into your body if you squeeze it.

- Biting apparatus of ticks is not a corkscrew, so do not to screw it out. Instead gently pull the tick straight out until its mouth lets go of your skin (*Picture 36*). Do not twist the tick. This may break off the tick's body and leave the head in your skin.
- Put the tick in a dry jar or zip lock bag and save it in the freezer for later identification if needed. Examination in a laboratory is a paid service in the Czech Republic
- After the tick has been removed, wash the area of the tick bite with a lot of warm water and soap and disinfect it.
- Do not apply petroleum jelly, fingernail polish, rubbing alcohol or a hot match to the tick – it can facilitate transmission of infection



Picture 36: How to remove a tick (from public source)

Lyme borreliosis (Lyme disease) is an infectious disease caused by the spirochete Borrelia burgdorferi that is transmitted by various insects and ticks. About 20 % of ticks are infected in CZ. Sometimes it goes unremarked – most dangerous is the chronic state, when the nervous system, joints and heart are attacked. The single typical sign is erythema migrans – a red spot, either homogenous or with pale centre (Picture 36: How to remove a tick (from public source)). It appears in 50 % of patients several days or weeks after the bite. Contact a doctor immediately. After sometime the spot disappears but in several weeks flu-like symptoms (fever, chills, fatigue, body aches and a headache) occur. Also these symptoms may go. Only in some patients illness continues to serious phase: inflammation of the meninges, temporary paralysis of one side of face (Bell's palsy), numbness, weakness, pain or pins and needles in limbs, and impaired muscle movement, loss of memory. Less common signs and symptoms are heart problems, eye inflammation, hepatitis, long-lasting severe fatigue.

Picture 37: Erythema migrans (from public source)

Tick-borne meningoencephalitis is an infectious viral disease transmitted by ticks. The first phase may go unnoticed or with flu-like symptoms. This lasts for up to eight days, after which point most people make a full recovery. In some people the second phase caused by the virus spreading to the layer of protective tissue that covers the brain and spinal cord (meningitis) or the brain itself (en-cephalitis) appears. These 'second-stage' symptoms can include: changes in mental state, such as confusion, drowsiness or disorientation, seizures (fits), an inability to speak, paralysis (inability to move certain body parts). In some cases the disease is fatal. Preventive vaccination is available and strongly recommended in the Czech Republic.

8.8. Crush syndrome

Causes: Trauma and ischemia involving soft tissues, principally skeletal muscle, due to prolonged severe crushing (burying under soil, debris etc.). It leads to compression of vessels and ischemia of a large mass of muscles, with increased permeability of their cell membranes and to heavy release of potassium, enzymes, and myoglobin from within cells. After reperfusion, these substances are released into the systemic circulation. Ischaemic renal dysfunction secondary to hypotension and diminished renal perfusion results in acute renal failure, secondary injury to lungs and heart. Massive oedema of the crushed limb results in hypovolemic shock.

History: burying under soil, debris, heavy objects etc.

Signs and symptoms: skin of affected area is cold, pale, with blisters and haematomas, swelling, absent pulse and capillary refill at periphery, signs of shock.

Picture 38: Crush syndrome of arm (from public source)

First aid:

- Activate EMS or integrated rescue system
- For a casualty crushed for less than 15 minutes
- Release as soon as possible
    - check for further injuries and provide first aid
    - immobilise any suspected fractures
    - check pulse and capillary refill
- For a casualty crushed for more than 15 – 30 (30 – 60) minutes
- Do not proceed with release of victim. Wait for EMS if buried longer than 30 – 60 min, or if it is absolutely necessary to survival, apply a tourniquet, cool buried extremity and apply anti-shock therapy as soon as you release him.

8.9. Blast injury

(*source* *https://en.wikipedia.org/wiki/Blast_injury*)

Causes: Direct or indirect exposure to an explosion. Note that these injuries are compounded when the explosion occurs in a confined space.

History: Patient will have been in the vicinity of an explosion.

Classification: Blast injuries are divided into four classes: primary, secondary, tertiary, and quaternary.

- Primary injuries

  These are caused by pressure waves, or shock waves caused by the blast. They are especially likely when a person is close to exploding munitions, such as a land mine. Hollow organs are most often affected by the pressure wave, for instance the middle ear. The most important traumas are those to the lungs and the hollow organs of the gastrointestinal tract. Be careful with monitoring patients in such settings, because gastrointestinal injuries may present after a delay of hours or even days. The injuries caused by blast pressure waves are is a pressure and time dependent function. By increasing the pressure or its duration, the severity of injury will also increase. In general, primary

blast injuries are characterised by the absence of external injuries; thus internal injuries are frequently unrecognised and their severity underestimated.

- Secondary injuries

  are caused by fragmentation and other objects propelled by the explosion. These injuries may affect any part of the body and sometimes result in penetrating trauma with visible bleeding. At times the propelled object may become embedded in the body, obstructing the loss of blood to the outside. However, there may be extensive blood loss within the body cavities. Fragmentation wounds may be lethal and therefore many antipersonnel bombs are designed to generate fragments.

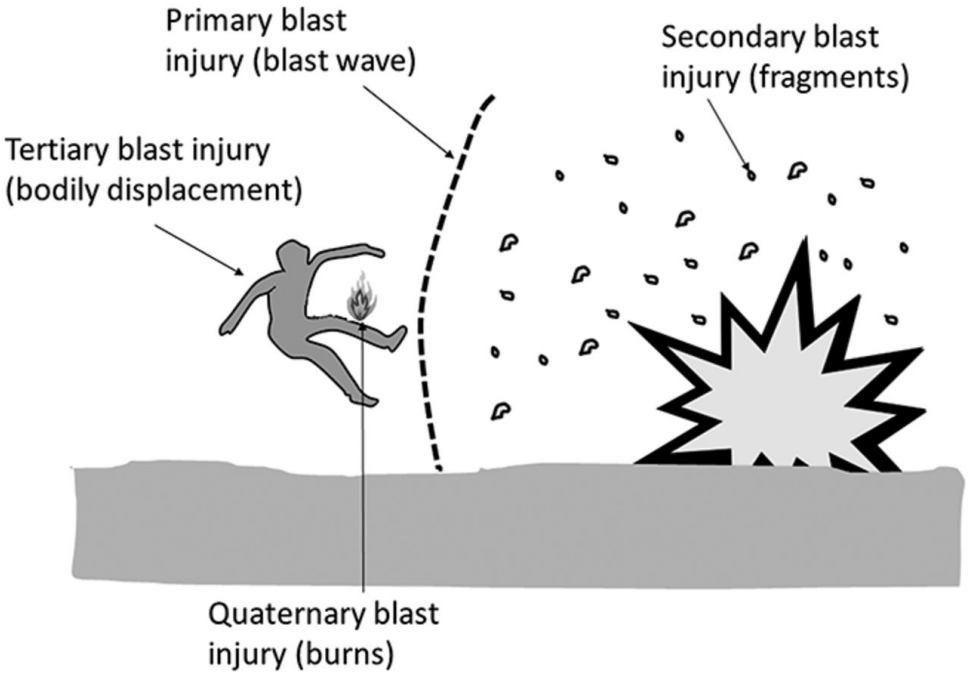
- Tertiary injuries:

  Displacement of air by the explosion creates a blast 'wind' that can throw victims against solid objects. Injuries resulting from this type of traumatic impact are referred to as tertiary blast injuries. Tertiary injuries may present as some combination of blunt and penetrating trauma, including bone fractures and coup/contre-coup injuries.

- Quaternary injuries:

  are all other injuries not included in the first three classes. These include flash burns, crush injuries, and respiratory injuries.

Signs and symptoms: depend on type of injury. Blast lung refers to severe pulmonary contusion, bleeding or swelling with damage to alveoli and blood vessels, or a combination of these. It is the most common cause of death among people who initially survive an explosion. Signs are dyspnoea, hemoptosis, etc. Most casualties are caused by secondary injuries. Some explosives, such as nail bombs, are deliberately designed to increase the likelihood of secondary injuries. In other instances, the environment provides the objects thrown into people, e.g., shattered glass from a blasted window or the glass facade of a building. Commonly high explosive rounds such as those used more militarised factions cause secondary injury due to masonry etc. These tend to cause fewer lacerations than glass, but more severe blunt force trauma. Traumatic amputations quickly result in death, and are thus rare in survivors, and are often accompanied by significant other injuries. Psychiatric injury, some of which may be caused by neurological damage incurred during the blast, is the most common quaternary injury, and posttraumatic stress disorder may affect people who are otherwise completely uninjured.



Picture 39: Mechanism of blast injury (from public source)

First aid:

- be safe – there can be no help given by a first aider who adds himself to the list of victims
- activate the Integrated Rescue System (112)
- Employ triage to effect the least cost in casualties. (see chapter *20 Mass casualty*, disaster)

9. Bandages

(main source http://www.ibiblio.org/hyperwar/USA/ref/FM/PDFs/FM8-50.PDF)

The proper bandage properly applied can aid materially in the recovery of a patient. A carelessly or improperly applied bandage can cause discomfort to the patient; in many instances it may expose the wound to danger of infection; it may even imperil the life of the patient. A bandage is used to hold a dressing in place over a wound, to create pressure over a bleeding wound for control of haemorrhage, to secure a splint to an injured part of the body, and to provide support to an injured part. A bandage should never be applied directly over a wound; it should be used only to hold in place the dressing which covers a wound. A bandage should be applied firmly and fastened securely. It should not be applied so tightly that it stops circulation or so loosely that it allows the dressing to slip. If bandages work themselves loose or become unfastened, wounds may bleed, they may become infected, and broken bones may become further displaced. It is essential, therefore, that bandages be properly applied and well secured.

Bandages are classified according to various criteria

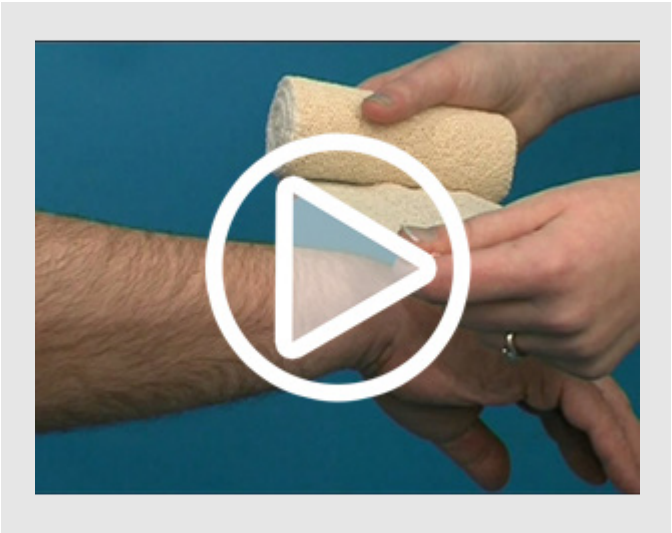
- according to function (dressing, splinting, extentioning, correcting, fixating)
- according to material (gauze, muslin, elastic, plaster etc.)
- according to the shape (triangular bandages, roller bandages, and tailed bandages etc.).

9.1. Bandaging

- Explain the procedure, to gain cooperation.
- Roller bandages should be applied evenly, firmly, and not too tightly. Excessive or uneven pressure will interfere with the circulation and harm the patient.
- In bandaging an arm or leg, the entire extremity (except the fingers or toes) should be covered to maintain uniform pressure. The fingers or toes should be left exposed so the circulation in these parts can be checked.
- An extremity should be bandaged in its final position, since bending will change the pressure of parts of the bandage.
- It is safer to use a large number of turns rather than a few too firmly applied turns to secure splints or dressings. This is particularly important in applying a wet bandage, or one that may become wet while securing a wet dressing. A wet bandage will be unduly tightened when it dries if allowance has not been made for shrinkage.
- Bandage turns should overlap to completely cover the skin, since any uncovered skin may be pinched between the turns. To prevent chafing and irritation when two parts are bandaged together, skin surfaces should be separated by absorbent material.
- The width of the bandage should be 1.5 times the diameter of the treated part of body
- Hold the roller in your hand to roll it easily (see *Video 8: Bandaging and dressing technique*)
- Initial turns should be applied securely and, when possible, around the part of the limb with the smallest circumference. The wrist and the part immediately above the ankle are preferred for anchoring appropriate bandages. (Wrist anchors and ankle anchors are applied similarly.) To apply a secure wrist anchor, the following steps are taken.

- Lay bandage end obliquely across top of wrist and then bring under wrist and back to starting point.
- Fold uncovered triangle of end back over second turn.
- Cover by third turn, completing the anchor.

- Bandages are terminated by applying several overlying circular turns and fastening the ends securely. The ends may be tied, pinned, or fastened with adhesive tape.
  - The end of the bandage is folded back upon itself to form two ends which can be tied.
  - The end of the bandage is split lengthwise for a suitable distance and a simple knot tied at the end of the tear.
  - The split ends are then brought around in opposite directions and tied. The square knot illustrated in *Video 8* is the best type of knot for tying bandages. It will hold firmly and can be easily unfastened.
- Advise your patients about possible complications (see below). If any occurs, remove and reapply the bandage.
- Too tight bandage.
  - pain
  - blue (cyanotic) or pale (anaemic) fingers (fingernails)
  - pins and needles (paraesthesia) or loss of sensation distal from bandage
- Infection (5 local signs and systemic complications)
  - rubor (redness
  - calor (increased heat)
  - tumor (swelling)
  - dolor (pain)
  - functio laesa (loss of function)
  - systemic signs: fever, shivering, malaise



Video 8: Bandaging and dressing technique

Triangular and cravat bandages

The triangular bandage is used for the temporary or permanent bandaging of wounds, the immobilisation of fractures and dislocations, and as a sling for the support of an injured part of the body. It is valuable in emergency bandaging since it is quickly and easily applied, stays on well, and can be improvised from a piece of shirt, an old sheet, a large handkerchief, or any other pliable material of suitable size. The long side of the triangle is called the "base", the point opposite the base is called the "apex" – the points at either end of the base are called the "ends" or "extremities". This bandage may be used either as a triangle or as a cravat, the latter being made from the triangle by bringing the apex to the base and

folding it upon itself a sufficient number of times to obtain the desired width. The names of the triangular and cravat bandages indicate the part of the body to which the bandage is applied. In many of the illustrations of bandages in this manual, the dressings have been omitted for the sake of clarity.

Roller bandages

Roller bandages are the most commonly used. Application of these bandages is an essential knowledge for every first aid provider (see below).

Tubular bandages

The tubular bandage is used for a wide variety of applications. It is used to retain wound dressings and padding material, as well as to protect the skin under plaster of Paris and synthetic casts and compression bandages. REMEMBER: after widening the bandage shortens. It must be cut longer, than expected (see *Picture 40*).

Picture 40: Tubular bandage (from public source)

Adhesive tapes

Adhesive plasters can be used for fixation or dressing of small wounds. Some people are allergic to some types of adhesive plasters. Adhesive plasters can be used for fixation of broken ribs (see further). For this purpose, broad adhesive plasters with perforations are the best. Always apply during expiration. Apply 10 cm broad strips from spine to breastbone roof-like starting caudally and continue strip by strip cranially.

Next possibility is broad strip of adhesive plaster applied circularly around chest during expiration or use elastic bandage or improvise with broad strip of cloth.

Adhesive bandage for small cuts – Use a strip bandage for small cuts. The most common type of bandage is a strip bandage – traditionally known in America as a bandaid, and the UK as a plaster. These are best used on small cuts and abrasions that occur on a flat surface. To apply, simply remove the wax paper backing and position the gauze-portion over the wound. Use the sticky wings to secure the bandage, being careful not to pull them too tight or the bandage will peel off.

A butterfly bandage can be recognised by two sticky adhesive strips connected by a thin, non-sticky strip of bandage. This style is used for keeping a cut closed, not for absorbing blood or preventing infection. If you have a slice or cut that can be 'pulled apart', you may consider using a butterfly bandage. Peel off the backing, and then place the bandage so that the sticky parts are on either side of the cut. Pull the closure a bit tight, to help close off the cut. The non-sticky centre strip should be located directly over the wound.

Plaster of Paris and similar material bandages are not used in first aid.

9.2. Bandaging technique

(for details see videos and http://www.ibiblio.org/hyperwar/USA/ref/FM/PDFs/FM8-50.PDF)

9.2.1. Bandaging the head

Video 9: Bandaging – head

Triangle of forehead or scalp is used to hold dressings on the forehead or scalp. To secure, place the middle of base of triangle so that edge is just above the eyebrows and bring the apex backward, allowing it to drop over back of head (occiput). Bring the ends of the triangle backward above the ears and cross them over the apex at occiput. Tail the ends back around to the forehead to completely encircle the dome

of the scull, and tie them in a square knot. Turn up the apex of the bandage toward the crown and pin it with a safety pin or tuck it in behind the crossed part of the bandage.

Cravat of eye – bring the apex of the triangle to the base and fold it upon itself a sufficient number of times to obtain the desired width of cravat. Put on dressing of injured eye and tie behind the head as if it were a blindfold.

Cravat of head or ear – the purpose of this bandage is to apply pressure to control haemorrhage from wounds of scalp, or to hold dressings on wounds of the ear or lower scalp. Place the middle of the cravat over dressing, pass each end completely around head and tie in square knot. Or you can use two cravats. Lay the centre of the first cravat over the crown with the front end falling over the uninjured eye. Bring the second cravat around the head, over the eyes, and over loose ends of the first cravat. Tie in front. Bring the ends of the first cravat back over the top of the head, tying there and pulling the second cravat up and away from uninjured eye.

Four-tailed bandage of the jaw and chin. The four-tailed bandage of the jaw is used for holding a dressing on the chin or jaw. A bandage of desired length and width is used. Split bandage lengthwise from each end to within 7 – 12 cm of centre of strip. Place the uncut centre of the bandage over the chin, and then carry the two upper of the split ends along each side of jaw, and tie at nape of neck in a fashion resembling a surgical mask. Fold the body of the bandage under the chin and then tie the lower set of split ends over the crown in the manner of a headband, on top of the head.

Four-tailed bandage of the nose – this bandage is used for holding a dressing around the nose. A four-tailed bandage of the desired length and width is used. Split the bandage lengthwise from each end to within 8 – 12 cm of the centre of the strip in the same manner described above. Place the body of the bandage over the nose. Take the upper set of split ends and trace them below the ears, tying them at the nape of the neck. The lower set of split ends you must trace to the occiput and tie them off.

Recurrent bandage of head with two bandages – This bandage is used to hold dressings on scalp when assistance is not available. Tie two bandages together with a square knot. Place a knot on the forehead and bring both rolls back above ears. Cross bandages at back of head, bringing roll No. 1 upward over top of head. Continue roll No. 1 over top of head to forehead and bring roll No. 2 around head, over other bandage and around to side of head. Bring roll No. 1 from forehead over top of head to nape of neck. Bring roll No. 2 over folds of roll No. 1 at nape of neck juncture, and continue around head to front. Bring roll No. 1 back over top of head and repeat procedure, alternating to the left and right of the mid line, each turn overlying the outer half of the preceding turn. Cover the head, bring both rolls to front with several circular turns around head and secure the bandage.

Recurrent bandage of head with one bandage – is used to hold a dressing on the scalp. Anchor bandage with several turns around the head, terminating behind head. At this point fold bandage upward, with assistant or patient holding fold in place with two fingers. Continue bandage over top of head to centre of forehead Fold bandage back at this point and hold it there with your free hand. Carry the bandage back to the point held by your assistant at the rear of the head. Continue procedure until entire head is covered, turns alternating to the left and right of the centre line and each turn overlying the outer half of the preceding turn. Finally, apply several circular turns around the head, covering the ends of the initial turns, and secure the bandage.

9.2.2. Bandaging and splinting of upper extremity

Video 10: Bandaging – upper extremity

Adhesive plaster on the tip of finger – Use a butterfly bandage (what the leyman would considder a plaster, or bandaid) for slices and cuts. A butterfly bandage can be recognised by two adhesive strips connected by a thin, non-sticky strip of bandage. This style is used for keeping a cut closed, not for absorbing blood or preventing infection. If you have a slice or cut that can be 'pulled apart', you may consider using a butterfly bandage. Peel off the backing, and then place the bandage so that the sticky parts are on either side of the cut. Pull the closure a bit tight, to help close off the cut. The non-sticky centre strip should be located directly over the wound.

Triangle of Hand is used to hold dressings of considerable size on the hand. Place the middle of the base of the triangle well up on the palmar surface of the wrist. Trace the apex around the ends of the fingers, and continue back to the wrist, covering the (dorsum) of the hand, and tuck any excess of material into small pleats on either side of hand.

Cravat of palm of hand – Lay the centre of the cravat over the centre of the palm, with it's ends hanging down either side of the hand. Bring the thumb end across the back of the hand, over the palm, and through hollow between thumb and palm. Bring the other end across back of hand, toward of the base of the thumb, and obliquely across the palm to the base of the little finger. Cross both ends over the back of the patient's hand. Continue the procedure until there is no material left with this principal of first crossing the ends at the back of the hand and then over the palm. Finish by tying in a square knot at the wrist.

Triangular Arm Sling is used for the support of fractures or injuries of hand, wrist, and forearm. Bend the arm at the elbow so that little finger is about a hand's width above the level of the elbow. Place one end of the triangular bandage over the shoulder on injured side and let bandage hang down over chest with base toward hand and apex toward elbow. (considder this as though it is a triangle pointing toward the outside of the body, and pointing toward the injured side of the body). Slip the bandage between the body and arm and thread the lower end up over shoulder on uninjured side. Tie the two ends, by square knot, at the neck. Draw the apex of the bandage towards the elbow until, and then bring it around to the front, and fasten with a safety pin or adhesive tape.

Finger bandage. Anchor the bandage at the wrist. Bring over the back of the hand and make one complete turn at base of injured finger: over dressing. Make spiral turns to the tip of the finger to hold dressing while applying bandage. Make another spiral turn back to base of finger and complete bandage with figure-of-eight, progressing from tip to finger base. Terminate with circular turns around wrist and secure.

Bandage of back of hand, with palm and fingers exposed. Anchor with the bandage wiith primary turns around the wrist. Bring the bandage to the back of hand, place spacers between fourth and little finger;

then around base of little finger and across back of hand to wrist. Circle the wrist and repeat on other fingers. Terminate at the wrist, and secure the bandage.

Complete bandage of the hand. Anchor at the wrist, and then fold the bandage back, over the back of the hand to the tip of the forefinger. Continue over to the front of the fingers and palm to the wrist, repeating the procedure four or five times, covering all involved fingers, except the thumb. (Hold folds at the wrist until the next step.) Circle around the folds at wrist to secure them. One should then bring the bandage obliquely across the back of the hand to the tip of the fingers. Make a circular turn near the ends of the fingers and continue with a figure-of-eight pattern. Terminate with several circular turns around wrist and secure.

Elbow Bandage is used in two type

1. Figure-of-Eight of Elbow Bandage is used to hold a dressing in the cubital fossa. Anchor the bandage with a circular turn above elbow and trace the bandage obliquely downward over hollow of the elbow. Circle the bandage around the forearm below the elbow to anchor, and bring obliquely up- ward over the hollow of the elbow, and pass around the upper arm at over the top of the first wrapping. Repeat the procedure with oblique turns progressing up the forearm, each turn overlapping the preceding turn by two-thirds. Terminate at the starting point, and secure it.
2. Frontal Elbow Bandage is also used to hold dressings on the cubital fossa. Unlike the figure-of-eight bandage, this bandage leaves the olecranon exposed. It allows movement of the joint without disturbing the dressing. One must Anchor the bandage to the arm with circular turns around the forearm below the elbow. Trace the bandage obliquely upward over cubital fossa, and circle the arm just above elbow. Bring the bandage obliquely downward over the hollow of the elbow, and pass around the forearm at over the primary wind. Repeat the procedure until the cubital fossa is covered with each oblique turn overlapping the preceding by three-quarters of it's width. Terminate at the circular turns above elbow, and secure.

Pressure bandage

Video 11: Bandaging – pressure bandage

A pressure bandage is a form of bandage that is intended to compress a wound in order to prevent excessive blood loss usually from extremity. Lay the patient down, and elevate injured extremity above heart level. To apply a pressure bandage, first attempt to control the bleeding by placing pressure on the wound with a wad of gauze. Next, wrap the wound and the gauze with a bandage. Do several turns with roller bandage to fix dressing and apply compression layer, e.g. another unrolled bandage. Ad firm turns with the rest of the first bandage. If the bandage becomes saturated with blood, add new layers, do not remove it. If it does not help, use a tourniquet as described earlier in this text.

9.2.3. Bandaging and splinting of lower extremity

Bandaging of the lower extremity is achieved similarly to that of the upper extremity.

Video 12: Bandaging – lower extremity

Triangular bandage of the foot – similar to triangle bandage of hand.

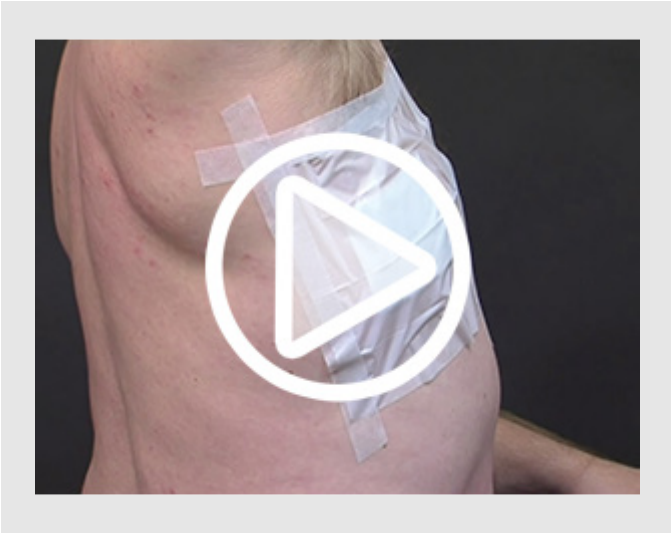
Bandage of big toe – similar to bandage of fingers. Anchor the bandage above the ankle, continue through dorsal part of foot to the toe, do a turn, continue obliquely over dorsum to sole of foot and back to the ankle. Repeat it until the toe is covered, then terminate and fix at the ankle.

Spica of foot is used to hold dressings on foot, and for support of sprained ankle. Anchor around the foot near the base of the toes. Trace the bandage obliquely across the instep and around heel. Continue obliquely across the instep, crossing the preceding turn to the base of the big toe. Repeat this procedure, turns gradually ascending on both foot and heel, crossings being in line along middle of instep. Continue procedure and terminate and secure above ankle.

Bandage of knee and heel – similar as bandage of elbow.

9.2.4. Bandaging of trunk

Adhesive plasters, broad roller or tubular bandages may be used to fix dressings on the trunk (see *Picture 40*). Special treatment is used for pneumothorax and fractured ribs (see also chapter *13.1 Loss of mechanical function of chest*) and abdominal injury (chapter *14 Acute abdomen*).



Video 13: Bandaging – trunk

Treatment of pneumothorax

Patient is usually treated in sitting position. Apply sterile dressing and cover with airtight clean plastic sheeting. Fix the sheet with adhesive tape from 3 sides. The remaining side should be left free, so that the sheet acts as a one-way valve. During expiration air can escape from the chest, but during inspiration the sheet adheres to the chest wall and the air cannot enter the pleural cavity.

Fixation of ribs – the aim is to prevent ribs from movement (main breathing muscle, diaphragm, will provide sufficient ventilation) Adhesive plasters can be used. For this purpose, broad adhesive plasters with perforations are the best. Always apply during expiration. Apply 10 cm long strips from spine to breastbone roof-like starting caudally and continue strip by strip cranially. It is also possible to use a broad strip of adhesive plaster applied circularly around chest during expiration or use elastic bandage or improvise with broad strip of cloth.

Bandages of abdomen do not use any special technique. The patient is usually treated in the supine position with flexed lower extremities. Do not manipulate the wound, neither replacing material nor removing foreign bodies. Cover the wound with sterile or at least the most clean material (e.g. ironed tablecloth) and call EMS. Do not give anything to drink or eat.

10. Positioning and transport

Proper position and mode of transport are an important part of first aid. Patients are usually attended by a responsible person.

10.1. Manipulation of a Patient and Transport to Hospital

Extrication – In the case of a road traffic accident, the decision to remove the victim from an automobile will be based on conditions that vary considerably among collisions. The type of accident, kinds of injuries, rescue equipment available and your knowledge are the major factors determining how much actual rescue you can accomplish. Removing the victim from a machine may or may not be the proper action. If the victim has been pinned or wedged in for some time and his or her breathing and circulation are satisfactory, make the victim as comfortable as possible. Then call medical and rescue assistance to the scene immediately. If imminent danger exists because of fire or the risk of additional injury, immediate rescue attempts are necessary. These actions depend upon the type of accident and the

victim's condition. Do not attempt to operate machinery to remove the victim unless you are thoroughly familiar with that particular machine. Rautek´s manoeuvre is usually used (see *Video 14: Extrication from a car*). If we are not able to do it ourselves, call for help professionals with appropriate technique (phone 112), (*Video 15: Extrication in case of spine injury*).

Walking with a victim – support with one hand and help him walk. Stay at injured or weaker side.

Manual transfer– baby and child up to 8 years can be transferred in arms, on back or shoulder. Adults can be transported only by employing more rescuers.

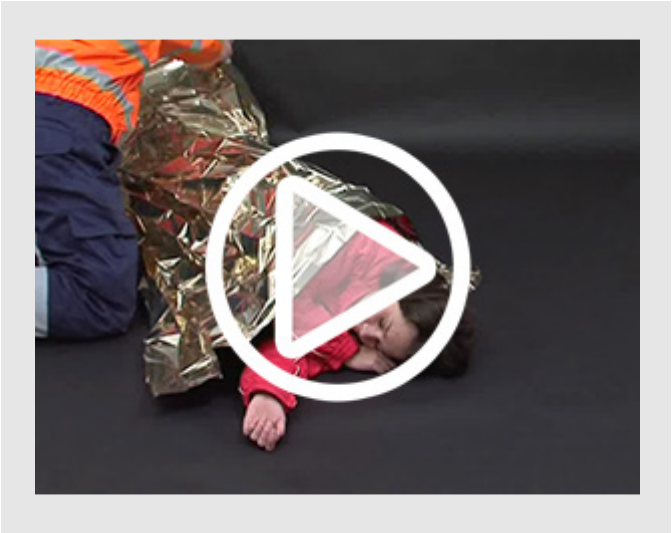
Dragging with immobilisation of the head – use Rautek´s manoeuvre (see *Video 14: Extrication from a car*)

Transport by 2 rescuers – carrying between, on “hand seat”, on carry blanket, sheet etc.

Use of stretcher – take care to proper preparation, cover, padding and fixation of a victim to prevent fall or failure.

Video 14: Extrication from a car

Video 15: Extrication in case of spine injury



Video 16: Stabilised and Rautek´s positions

10.2. Transport

Transport can be classified according to various criteria

according to transport providers

- by laymen
- by medical personnel

according to mode of transport

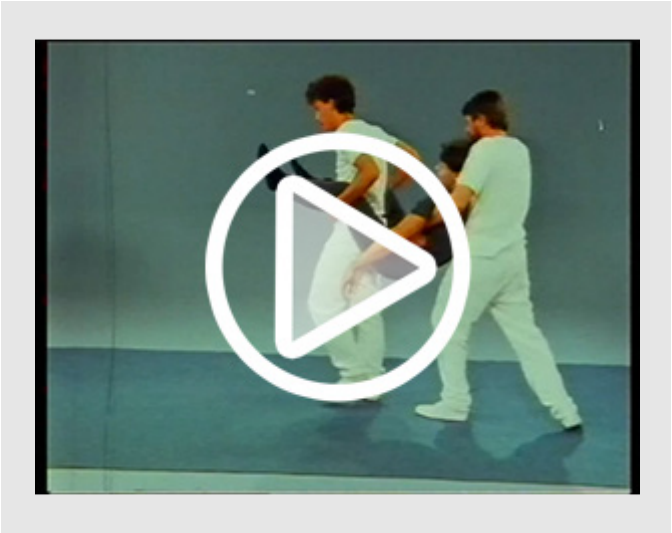
- by foot
- by car
- by train
- by ship
- by air

according to place of aiming

- primary – directly from site of accident
- secondary – between medical facilities

10.2.1. Basic principles of transport

Seriously injured or ill should not to be left alone at any time until casualty care has been passed to an ambulance crew. Upon arrival of an ambulance, responsibility for the casualty is transferred to the attending ambulance staff. Where the illness or injury is not serious or life-threatening, family member or friend can collect them and choose to transport themselves home or to medical aid by any means other than an ambulance (e.g. private vehicle or public transport). The most common ways of transport are presented in video (*based on film SZÚ První pomoc, výroba a distribuce Studio Grant*).



Video 17: Transport

11. Peripheral and central nervous system disturbances

11.1. Unconsciousness

Definition: loss of one of vital functions (central nervous system activity).

Classification:

1) Older and less accurate:

- Somnolence – a state of near sleep, reaction to verbal command preserved
- Stupor – no reaction to verbal command, reaction to tactile stimulation or pain preserved
- Coma – no reaction

2) Glasgow Coma Scale (GCS), worldwide used classification, is composed of three parameters: Best Eye Response, Best Verbal Response, and Best Motor Response.

REMEMBER: minimal score is 3, maximal score is 15

Best Eye Response. (4)

1. No eye opening.
2. Eye opening to pain.
3. Eye opening to verbal command.
4. Eyes open spontaneously.

Best Verbal Response. (5)

1. No verbal response
2. Incomprehensible sounds.
3. Inappropriate words.
4. Confused
5. Orientated

Best Motor Response. (6)

1. No motor response.
2. Extension to pain.
3. Flexion to pain.
4. Withdrawal from pain.
5. Localising pain.
6. Obeys Commands.

Note that the phrase 'GCS of 11' is essentially meaningless, and it is important to break the figure down into its components, such as E3V3M5 = GCS 11.

A Coma Score of 13 or higher correlates with a mild brain injury, 9 to 12 is a moderate injury and 8 or less a severe brain injury. (source *http://www.trauma.org/archive/scores/gcs.html*)

3) For laymen assessment, verbal description is the easiest option (spontaneous movements, pupil size, reaction to verbal or tactile command etc.).

Causes:

- **CNS disturbances**
  - Injury
  - Convulsions
  - Bleeding, ischaemia
  - Infection: meningitis, encephalitis, abscess
  - Brain herniation: brain oedema, tumours
- **Systemic disturbances**
  - Hypoxia
  - Loss of homeostasis
  - Medical diseases (diabetes, liver failure, kidney failure, thyroid gland diseases etc.)
- **Environmental factors**
  - Intoxications
  - Hypoxia
  - Extreme of temperature (hypo-, hyperthermia)

Signs: absent reaction to verbal command or light shaking, abnormal body position.

Do not use painful stimulation if first aid.

First aid: see Resuscitation. First aid procedures are usually the same irrespective of the cause of unconsciousness (symptomatic therapy). Definitive therapy is done after hospital admission. In victims who are unconscious, but have normal breathing and pulse and there is no probability of head and spine injury, nor have other contraindications like fracture of pelvis, long bones, spinal cord, shoulder injury and open abdominal injury use stabilized or recovery position. Prevent hypothermia and pressure sores, monitor vital functions. Injury – see *11.2 Skull and brain injury*.

Before EMS arrives, obtain history from bystanders of family members (history of stroke, diabetes, previous surgery, drugs, ampoules etc.)

REMEMBER: Clear signs of alcohol intoxication do not exclude head or brain injury!

11.1.1. Diabetic coma

Definition: Loss of consciousness caused by low level of blood sugar (loss of consciousness caused by high level of blood sugar is really rare).

History: diabetes treated by insulin, omitting food after high dose of insulin or strenuous exercise, typical signs

Signs and symptoms: pail skin colour, strong sweating, rapidly changing state of consciousness: starting from nausea, restlessness to abnormal behaviour, aggressiveness and unconsciousness

First aid: in conscious source of glucose (sugar, sweets, sweet cola (not cola light), **in disturbed consciousness or unconsciousness do never give anything eat or drink**, call EMS, standard care for unconscious (see *11.1 Unconsciousness*). Some diabetics are equipped with autoinjector with glucagon – a hormone that releases glucose from liver. You must follow instructions, how to use it. The kit consists of a syringe that contains liquid (diluent) and a bottle that contains the medicine.

Insert the needle into the bottle and push the liquid in. Remove the syringe and gently shake the bottle until the liquid becomes clear. Insert the syringe back into the bottle, and withdraw the medicine. Apply subcutaneously or intramuscularly

11.1.2. Orthostatic collapse (fainting)

Definition: Syncope (fainting) is a short loss of consciousness and muscle strength, characterized by a fast onset, short duration, and spontaneous recovery.

Causes: decrease in blood flow to the brain usually from low blood pressure. Vasovagal (situational) syncope is one of the most common types which may occur in response to any of a variety of triggers, such as scary, embarrassing or uneasy situations, during blood drawing, or moments of sudden unusually high stress. Orthostatic (postural) hypotensive faints are as common as or perhaps even more common than vasovagal syncope. Orthostatic collapse is most often associated with movement from lying or sitting to a standing position, standing up too quickly, or being in a very hot room. Other causes are fasting, exercise, abdominal straining, or circumstances promoting vasodilation (e.g., heat, alcohol, antihypertensive medications)

Prodromal symptoms: Some people have prodromal symptoms before the loss of consciousness occurs. These symptoms may include light headedness, sweating, pale skin, blurred vision, nausea, vomiting, and feeling warm, among others. Syncope may also be associated with a short episode of muscle twitching.

Signs and symptoms: Short loss of consciousness and muscle strength, characterized by a fast onset, short duration, and spontaneous recovery.

First aid:

- During prodromal symptoms – positioning the person on the ground, with legs slightly elevated or leaning forward and the head between the knees for at least 10–15 minutes, preferably in a cool and quiet place.
- After fall – antishock position, check vital functions, apply cold on forehead
- After the symptoms have passed, rest and some drink are recommended.
- If fainting spells occur often without a triggering event, syncope may be a sign of an underlying heart disease and needs medical examination.
- If unconsciousness continues – put a patient to stabilised position and treat as other unconsciousness
- Call EMS if a victim remains unconscious, if he has other problems like difficulty speaking, loss of vision, weakness or paralysis of one side of body, headache, convulsions etc.

11.2. Skull and brain injury

Definition: injury caused by kinetic energy against skull and brain.

Classification

1) Primary injury – direct trauma caused by to mechanical forces. They arise immediately after injury.

- Fractures of skull
    - fractures of calvaria
    - fractures of base of skull
- Brain injury
    - brain concussion
    - brain contusion
    - bleeding between meninges

2) Secondary injury – delate effect of mechanical trauma. The most common is brain oedema.

    - brain oedema (swelling)

Classification according to mechanism of injury:

I. Closed

- punches with blunt objects
- falls
- impacts
- ruptured artery, tumour, high blood pressure

II. Open

- punches with sharp objects
- high energy falls
- gunshot injuries

11.2.1. Broken skull

Definition: Loss of skull integrity caused by external forces.

11.2.1.1. Fractures of facial part of a skull

Signs and symptoms: bleeding or haematoma depending on extent and localisation of injury (see further)

Broken nose

Picture 41: Broken nose (source helpfulhealthtips.com)

Signs and symptoms: pain, nosebleed, change of shape, oedema

First aid: absorbent dressing fixed by four-tailed bandage, call EMS or transport by a car to ENT department ORL in sitting position with forward bended head. Do not give anything to eat or drink, urge to spit blood out instead of swallow it.

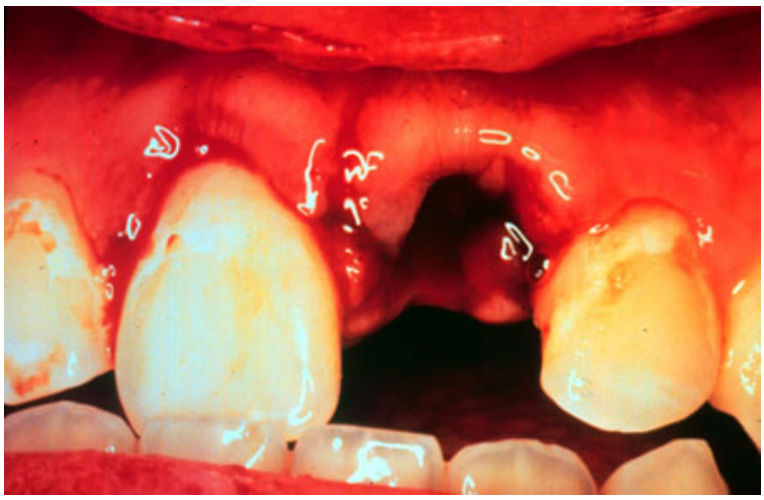
Broken mandible

Picture 42: Broken mandible (source calweb.com)

Signs and symptoms: pain, change of shape, bleeding, inability to bite.

First aid: fixation by four-tailed or cravat bandage, call EMS or transport by a car to ENT department ORL in sitting position with forward bended head. Do not give anything to eat or drink, urge to spit blood out instead of swallow it.

Tooth injury



Picture 43: Tooth injury (source lifeinthefastlane.com)

Signs and symptoms: pain, visible signs of tooth injury

First aid: arrange stomatology treatment. It's sometimes possible to successfully implant permanent teeth that have been knocked out, but only if it does not dry out. If reimplantation does not occur within two hours after the tooth is knocked out, the likelihood of success becomes poor — so it's vital to get emergency dental care. Handle the tooth by the top or crown only — do not touch the roots and try to put it back in the socket. If you can't put the tooth back in the socket, immediately place it between the cheek and gum. In case of difficult cooperation and/or risk the tooth can be swallowed, put it in some milk, victim´s saliva or a warm, mild saltwater solution — 1/4 teaspoon salt to 1 quart water. Get emergency dental care.

Baby teeth (primary teeth) are not implanted if they're knocked out.

Broken floor of orbit

Picture 44: Broken floor of orbit (source meded.ucsd.edu)

Signs and symptoms: pain, oedema, change of shape, diplopia (double vision).

First aid: call EMS or transport by a car to ENT department. Do not give anything to eat or drink.

Extensive facial fracturesu

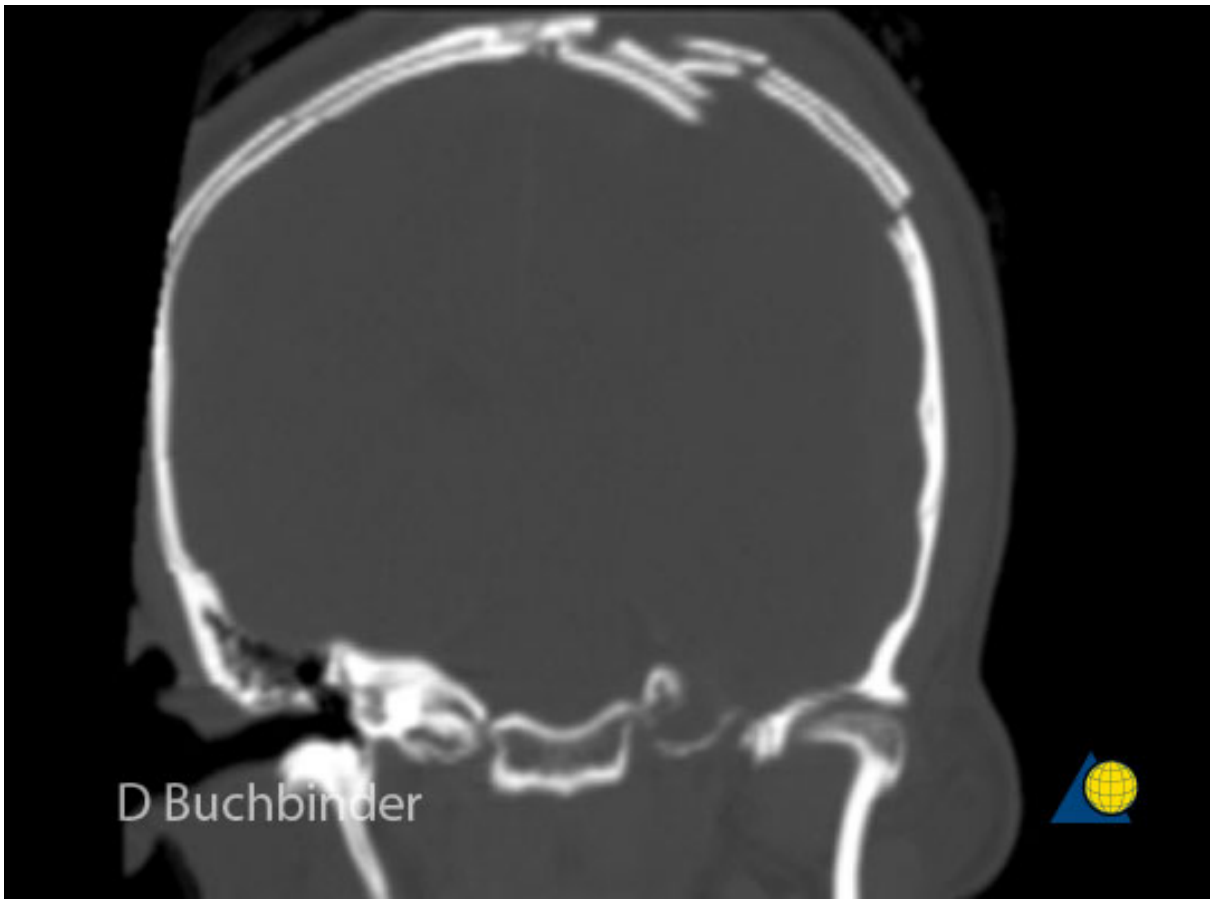
Picture 45: Extensive facial fractures (source documentingreality.com, atlas-emergency-medicine.org.ua)

Signs and symptoms: serious injury, loss of configuration of face, pain, bleeding from mouth and nose, frequently breathing problems

First aid: call EMS, monitor vital functions

11.2.1.2. Broken calvaria

Three times more frequent than fracture of base of skull. Present as rupture with fissure or impression.



Picture 46 Fracture of calvaria (source aofoundation.org)

Signs and symptoms: bleeding or haematoma, according to brain injury concussion, contusion and intracranial bleeding (see further).

First aid: never compress on bleeding would on the scalp; there is a risk of further impression of bony fragments to brain. Use only large amount of absorbing dressing (see chapter *9 Bandages*), call EMS and act as in other head and spine injury.

11.2.1.3. Fractures of base of skull

Picture 47: Fractures of base of skull (source aic.cuhk.edu.hk)

Signs and symptoms: racoon eyes haematoma, nose-bleed, bleeding from ear, vital functions disturbances.

First aid: call EMS and act as in other head and spine injury.

11.2.2. Brain injury

11.2.2.1. Brain concussion

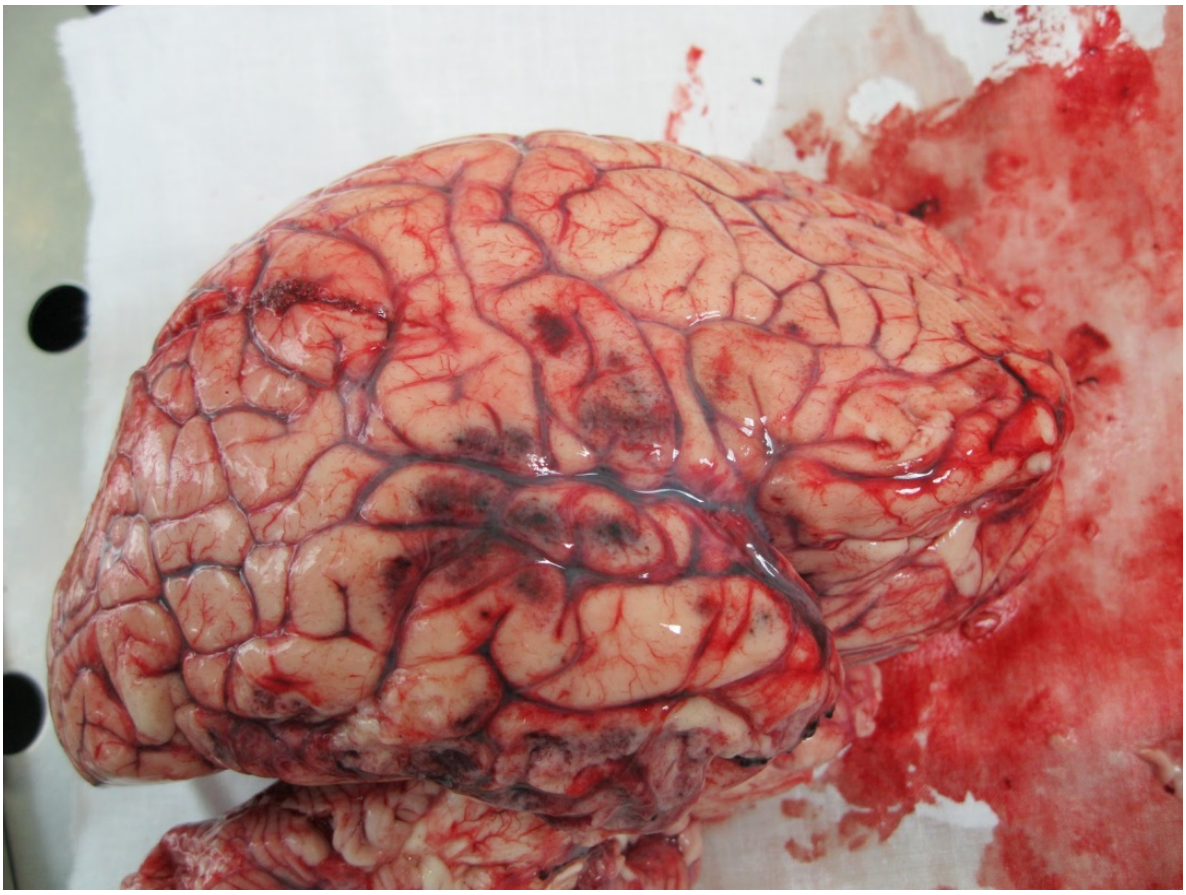
Definition: short-lasting functional CNS disturbance without organic lesion

Signs and symptoms: headache, nausea, vomiting, dizziness short amnesia (the victim cannot remember the circumstances of injury.

First aid: call EMS, control vital functions, treat other injuries if present

REMBER: every patient with brain concussion should be examined by a doctor and admitted to a hospital for 24 hours – there is always a risk of delayed brain injury.

11.2.2.2. Brain contusion



Picture 48: Brain contusion (source 2.bp.blogspot.com)

Definition: structural changes in brain tissue.

Signs and symptoms: depend of localisation and extent of the injury. Nearly always unconsciousness, paralysis, uneven pupil size, sometimes signs of skull fracture. Always suspect intracranial bleeding (see further).

First aid: call EMS, vital functions control, examination, treatment of other injuries, observation. Avoid back tilt of head. If there are no problems with airways, uses minor forward bend of head and elevation of upper part of body.

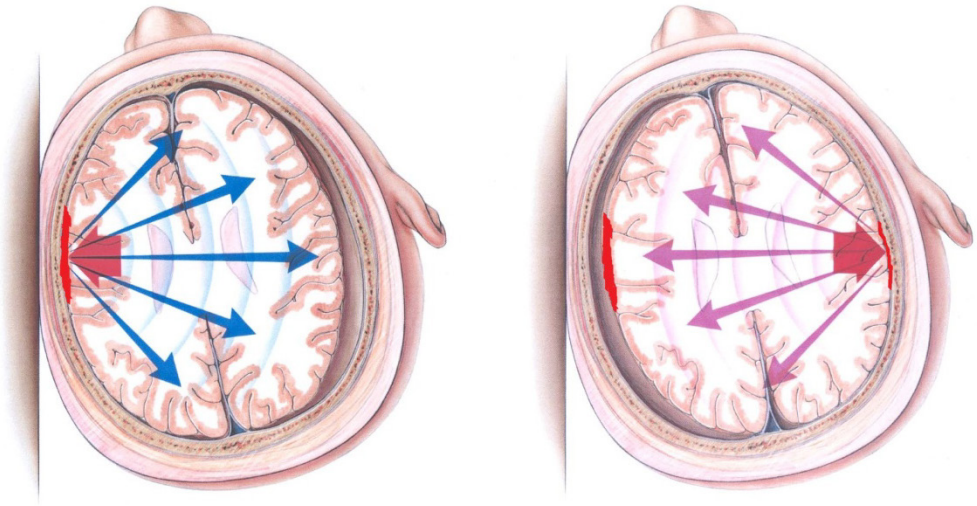
REMEMBER: severe head may accompanied with spine injury (see *11.3 Spine and spinal cord injury*)

NOTICE: contusion may be not only on the side of impact, but also on opposite site, where brain was hit by a skull during rebound (so called coup and contrecoup).

Mechanisms of Coup a Contrecoup injury

Primary impact
Coup

Secondary impact – Rebound
Contrecoup

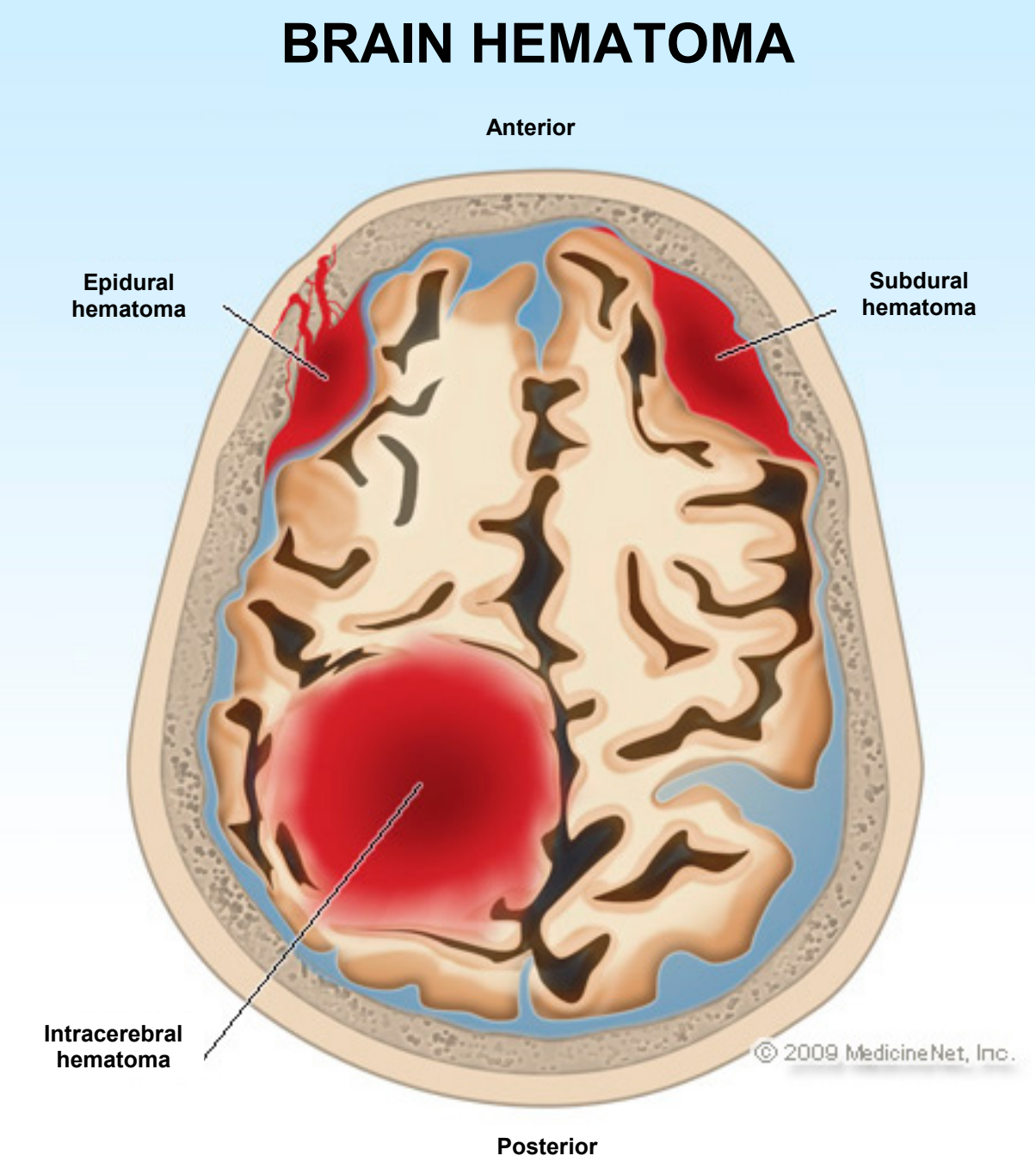


Picture 49: Coup and contercoup (source allaboutconcussion.info, neuropathology-web.org)

11.2.2.3. Intracranial bleeding

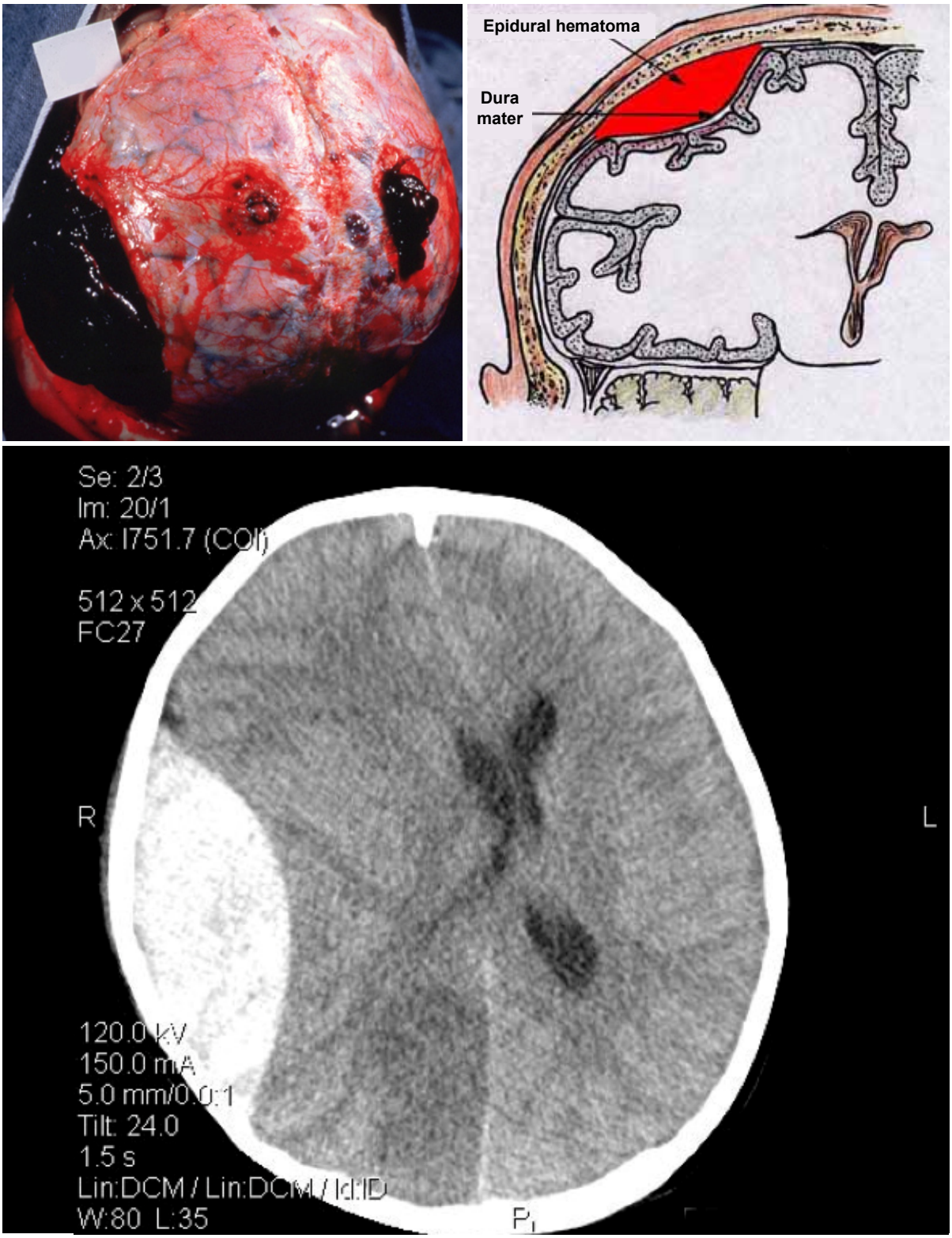
Definition: bleeding to cranial cavity, traumatic or non-traumatic (see *11.4 Stroke*)

Classification: see *Picture 50*



Picture 50: Intracranial bleeding – classification (source images.medicinenet.com)

Epidural bleeding – bleeding (usually arterial) between periosteum of skull and dura mater

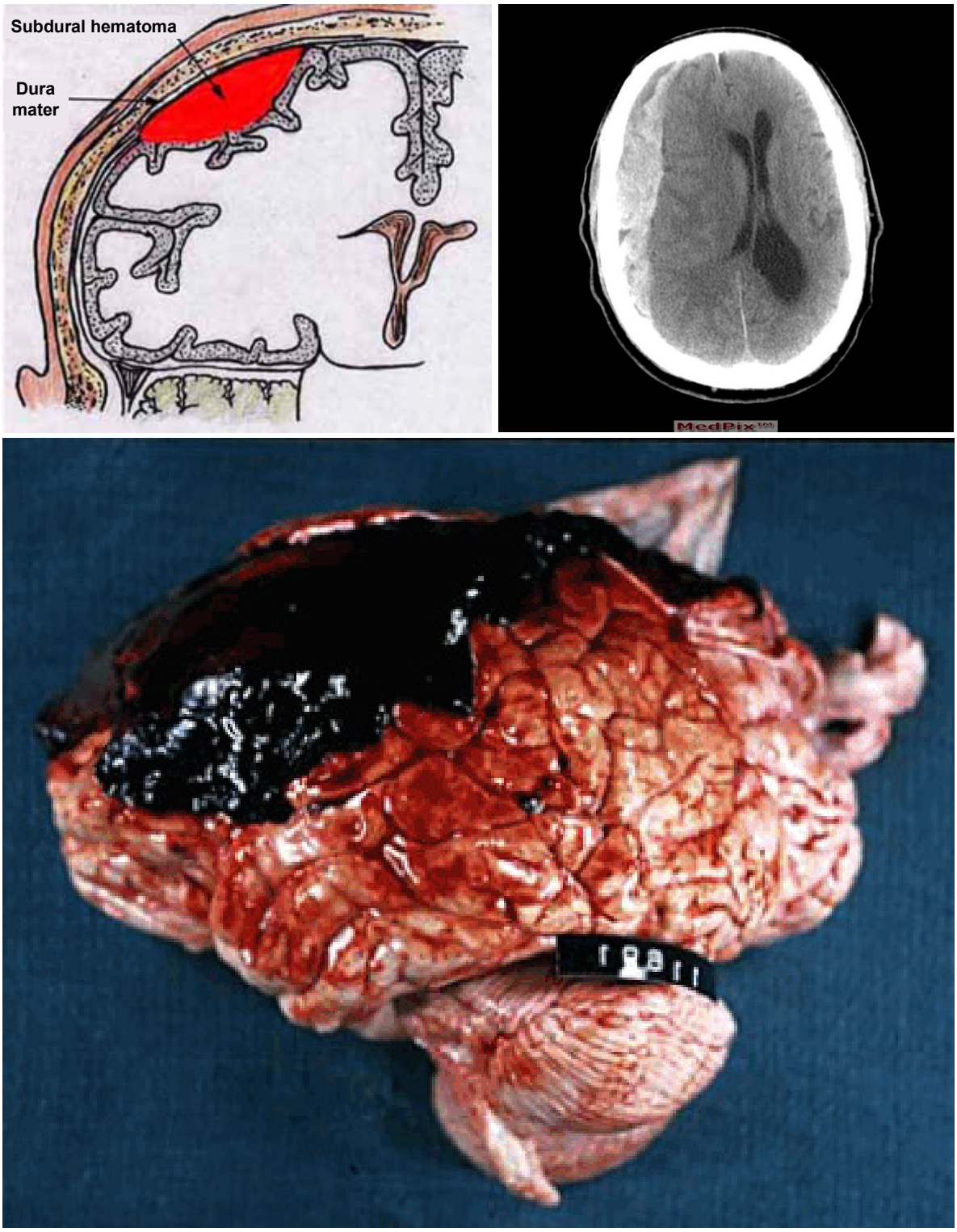


Picture 51: Epidural haematoma (source neuropathology-web.org, practicalhospital.com, cdemcurriculum.org)

Signs and symptoms: Progressive unconsciousness, uneven pupil size (dilated at the site of injury). Sometimes, there is a short interval of improvement before further deterioration.

First aid: see brain injury, call EMS, monitor vital functions. Neurosurgical treatment is necessary.

Subdural bleeding – acute bleeding (usually venous) between dura mater and arachnoid



Picture 52: Subdural bleeding acute (source 2.bp.blogspot.com, rad.usuhs.edu, farzad.devbro.com)

Signs and symptoms: Progressive unconsciousness, uneven pupil size (dilated at the site of injury). Paralysis and/or seizures on the opposite side.

First aid: Call EMS, monitor vital functions, supine position with mild elevation of upper part of the body. Avoid back tilt of the head. If there are no breathing problems, bend the head slightly forward. Therapy is neurosurgical

Subdural bleeding – chronic – results after minor bleeding between dura mater and arachnoid mainly in old people who sometimes don't remember the primary injury. Haematoma gradually colliquates (become liquid) and breakdown products are hyperosmolar. The volume increases by absorbed fluid and symptoms appear several weeks or month after primary injury.

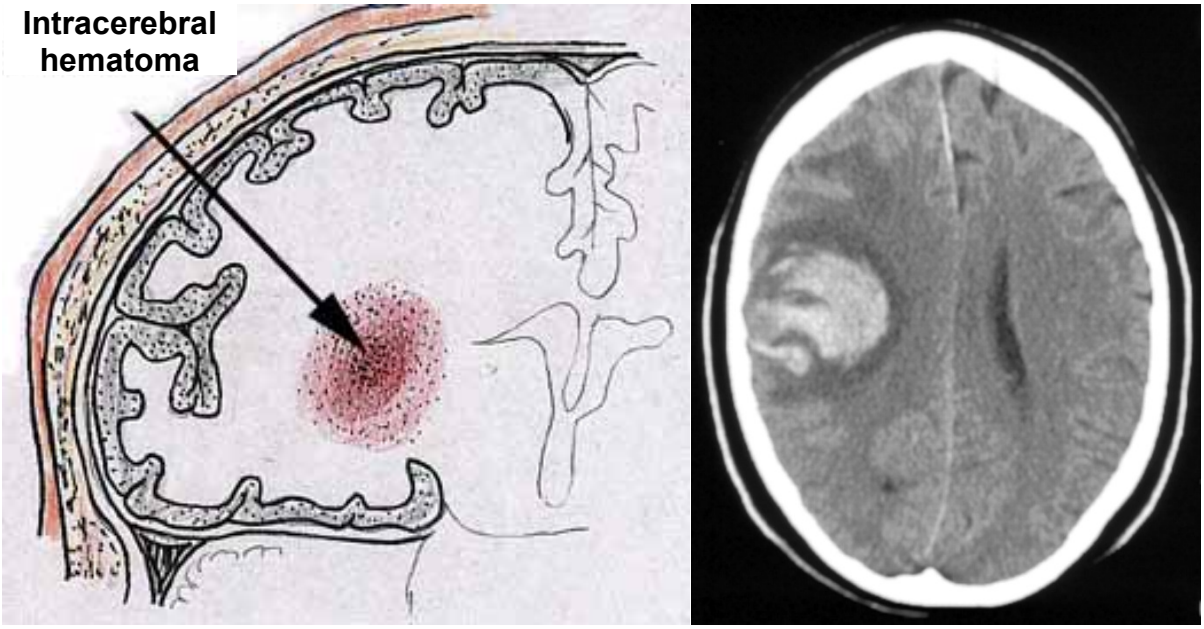
Picture 53: Subdural bleeding chronic (source radiology.co.uk)

Signs and symptoms: Changes in behaviour which worsen with time and eventually lead to decreased consciousness and uneven size of pupils (dilated at the site of injury). Paralysis and/or seizures may be present on the opposite side.

REMEMBER: Symptoms have a slower onset then epidural haemorrhage and are very non specific.

First aid: Call EMS, monitor vital functions, supine position with mild elevation of upper part of the body. Avoid back tilt of the head. If there are no breathing problems, bend the head slightly forward. Therapy is neurosurgical.

Intracerebral bleeding – injury to brain vessels could be traumatic (see *11.2.2.2 Brain contusion*) and non-traumatic (see *11.4 Stroke*)



*Picture 54: Intracerebral bleeding (source **practicalhospital.com**)*

Signs and symptoms of traumatic bleeding: see *11.2.2.2 Brain contusion*

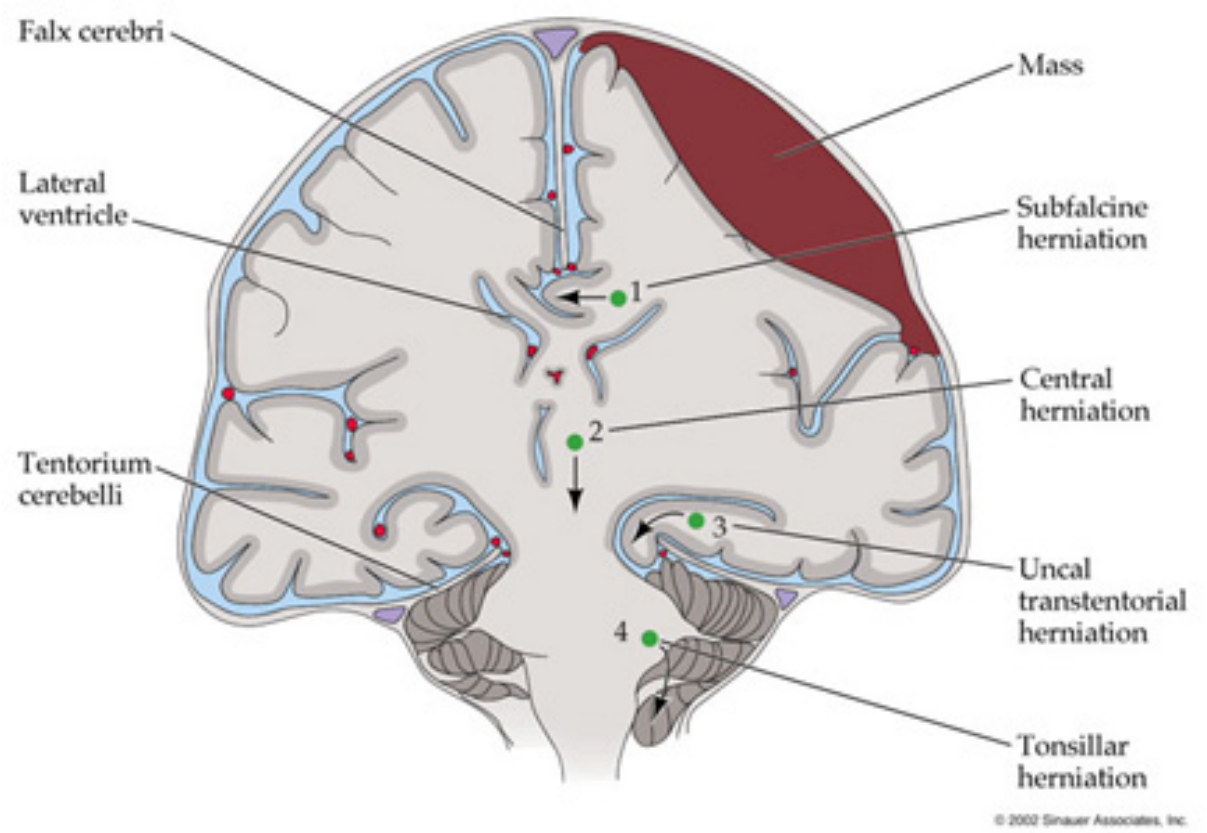
Signs and symptoms of non-traumatic bleeding: see *11.4 Stroke*

First aid: Call EMS, monitor vital functions supine position with mild elevation of upper part of the body. Avoid back tilt of the head. If there are no breathing problems, bend the head slightly forward.

REMBER: because of limited intracranial space, isolated intracranial bleeding does not result in haemorrhagic shock. Compensating mechanisms are increased blood pressure and decreases heart rate (Cushing´s reflex). The danger for the patient in this case is not blood loss, but increased intracranial pressure and compression of vessels resulting in hypoxia.

11.2.2.4. Brain oedema (swelling)

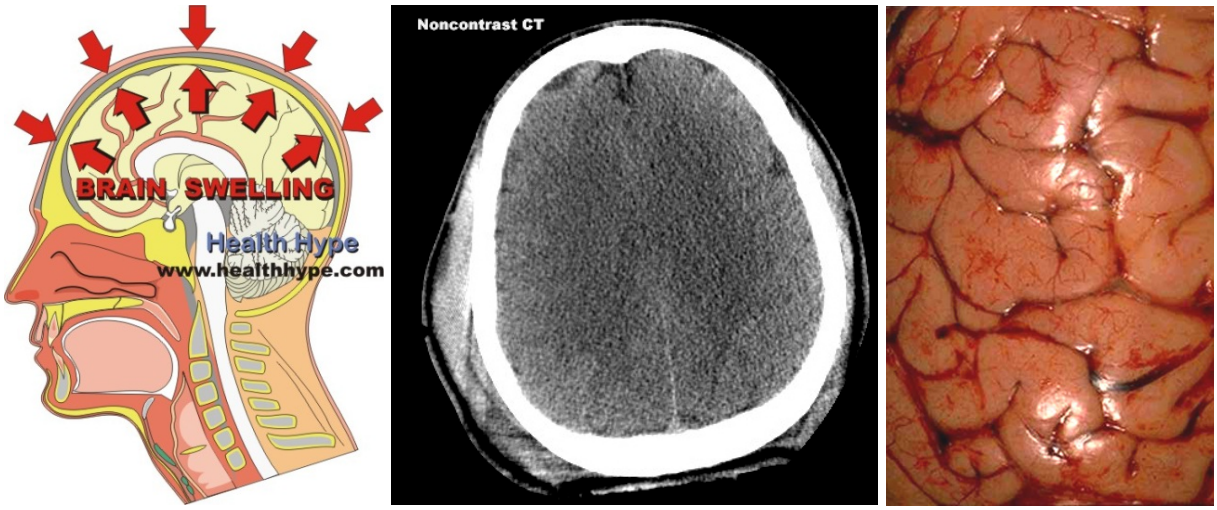
Definition: Swelling of the brain is a uniform reaction of the brain to any insult. It may be localised (around contusion, bleeding), or diffuse (general). There is risk of herniation: brain tissue becomes compressed in openings of the firm intracranial structures (falx cerebri, tentorium, foramen magnum) or by increased intracranial pressure. This causes ischaemia and brain cell death (leads to death of the patient).



Picture 55: Brain oedema, herniation (source missinglink.ucsf.edu)

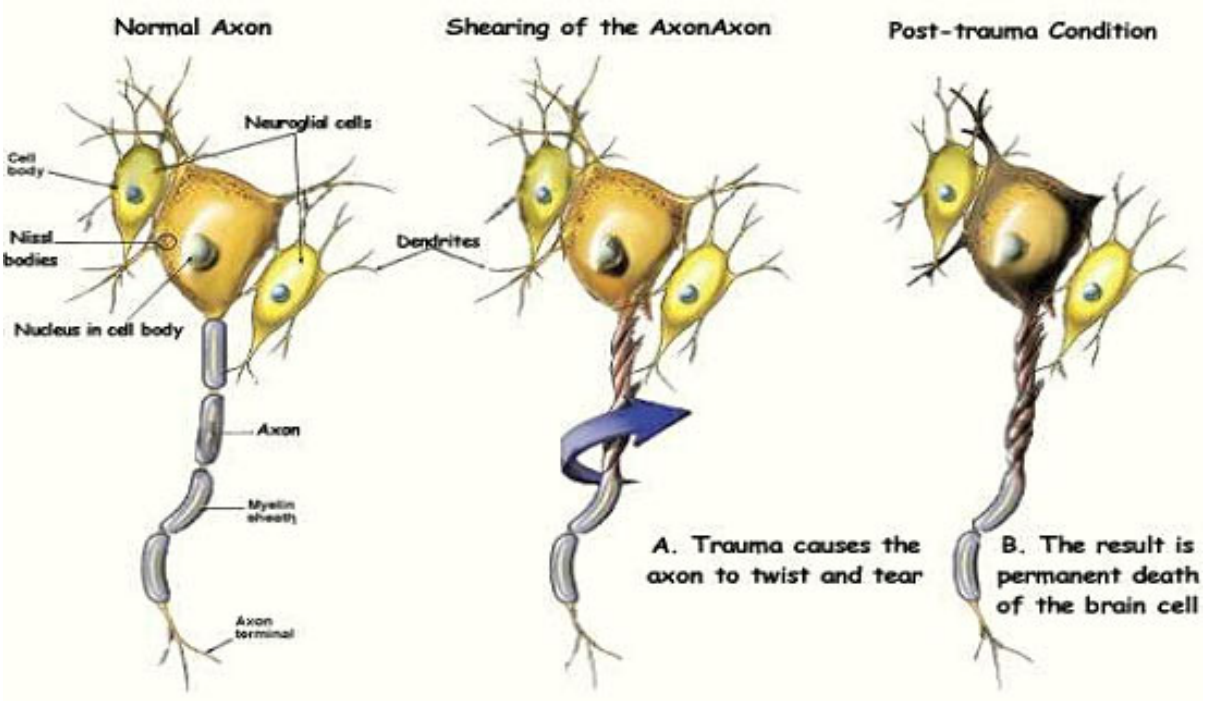
Signs and symptoms: decreased level of consciousness, breathing and circulation disorders

First aid: Call EMS, monitor vital functions, supine position with mild elevation of upper part of the body. Avoid back tilt of the head. If there are no breathing problems, bend the head slightly forward.



Picture 56: Brain oedema (source healthhype.com, meddean.luc.edu, blogspot.com)

11.2.2.5. Diffuse axonal injury



Picture 57: Diffuse axonal injury (source tbilawyers.com)

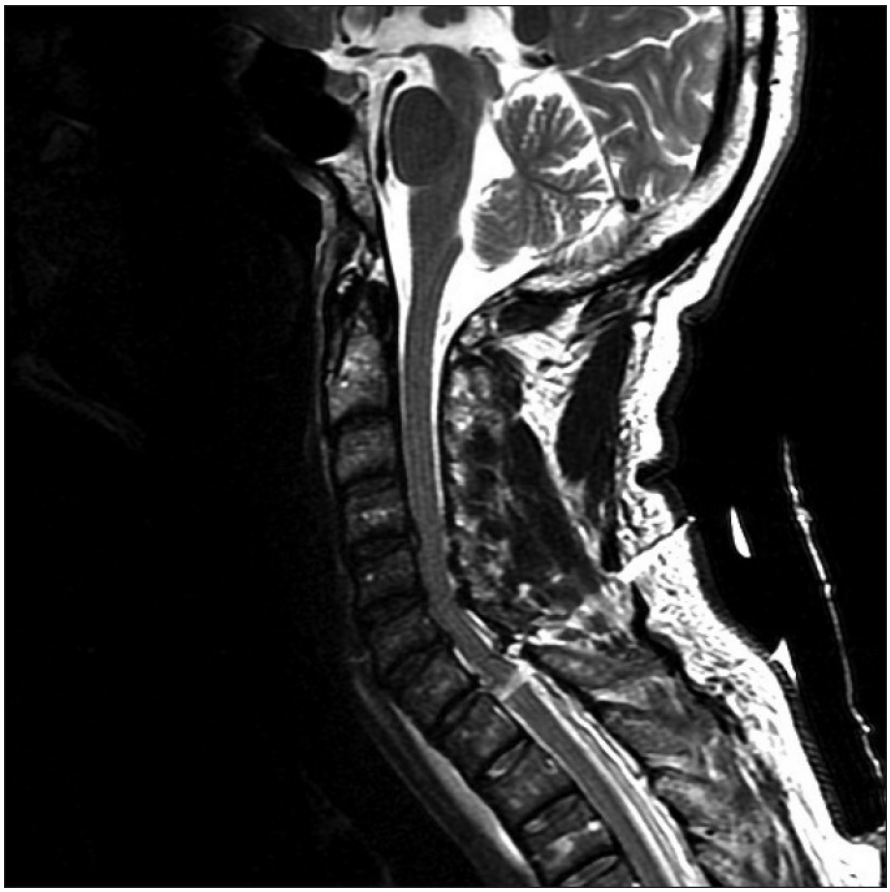
Definition: injury (tearing or post traumatic degeneration) of interneuronal connection in the brain which eventually causes brain cell death.

Signs and symptoms: neurologic symptoms lasting many days after surgery.

NOTICE: Diffuse axonal injury cannot be diagnosed or treated in first aid. Here it is mentioned only to complete information concerning brain injuries.

11.3. Spine and spinal cord injury

Causes: compression (fall from height), bending (lifting heavy objects), extreme rotation. Another common cause is whiplash injury which involves acute extension of cervical spine followed by flexion (see further). Spinal injuries are frequently accompanied by head injuries (in 74 %) and thoracic injuries (in 62 %). Spinal column injuries are caused by mechanical overloading of the spine. It results in injuries of ligaments, intervertebral discs or vertebrae. The most common localisation is cervical spine and the part between thoracic and lumbar spine.



Picture 58: Spine injury (source spinesurgeons.ac.uk)

Greater risk is in old people with osteoporosis and week spinal muscles. Even a minor blow may cause spinal injury in these people.

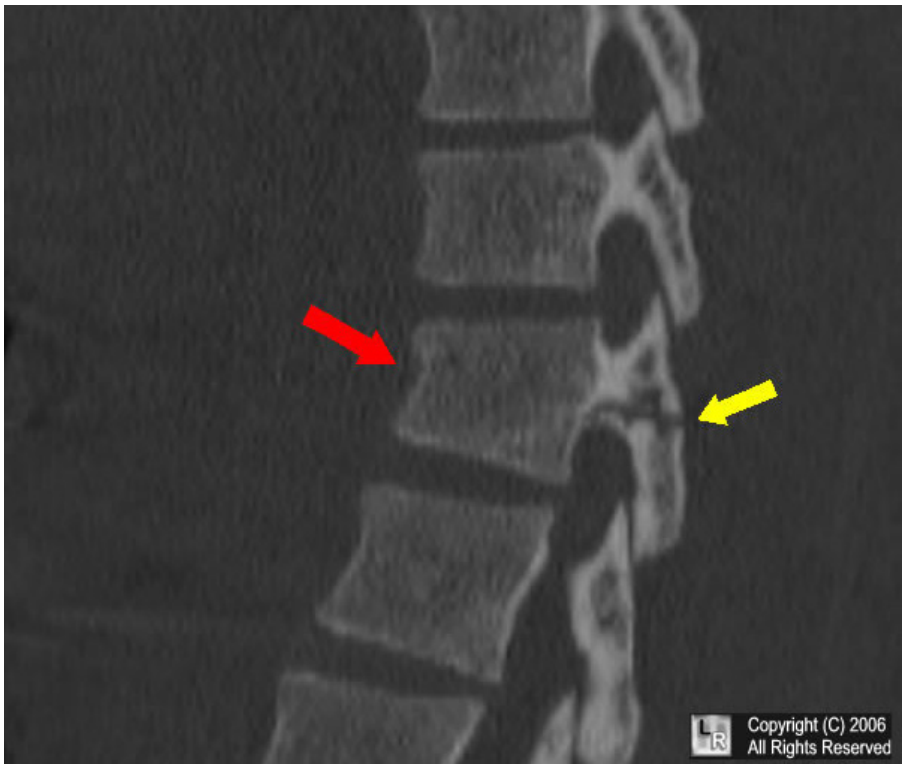
Classification

- Spinal injuries without spinal cord injury
- Spinal injuries with spinal cord injury
- Spinal injuries without spinal cord injury (rare)

11.3.1. Spinal injuries without spinal cord injury

History: Check the position of the patient, if they are lying on their back and not moving, it might be indicative for a spinal injury and also if the patient is conscious or unconscious. Look for signs of trauma near the spinal area to get an idea of the type of injury.

Signs and symptoms: back pain, loss of normal alignment of spinal processes, haematoma, no signs of paralysis or loss of sensitivity.

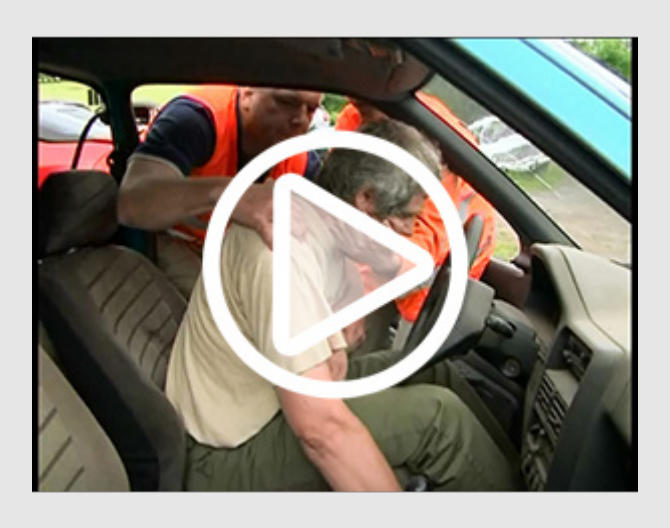


Picture 59: Spinal injury without spinal cord injury (source learningradiology.com)

First aid: call EMS, manipulate with the victim only in case of necessity like rapid extinction or treatment of vital function disorder (loss of breathing, major bleeding etc.). Secondary spinal cord injury during first aid is feared but its a rare complication. Main causes of secondary spinal cord injury are overlooking of spinal injury, wrong method of helmet removal, insufficient immobilisation during extinction and unnecessary use of recovery or stable side position. Rescuers should avoid repositioning the victim and manoeuvres leading to extensive flexion, extension or rotation of the spine. Do not move or transport the victim by holding or pulling him by his hands and legs. Optimal position is lying on firm surface with the head fixated by support from both sides or by use of an improvised cervical collar. Helmet removal is only indicated with spine immobilisation (see video or *https://www.facs.org/~/media/files/quality%20programs/trauma/publications/helmet.ashx*)

Video 18: First aid at the site of accident. A motorcyclist

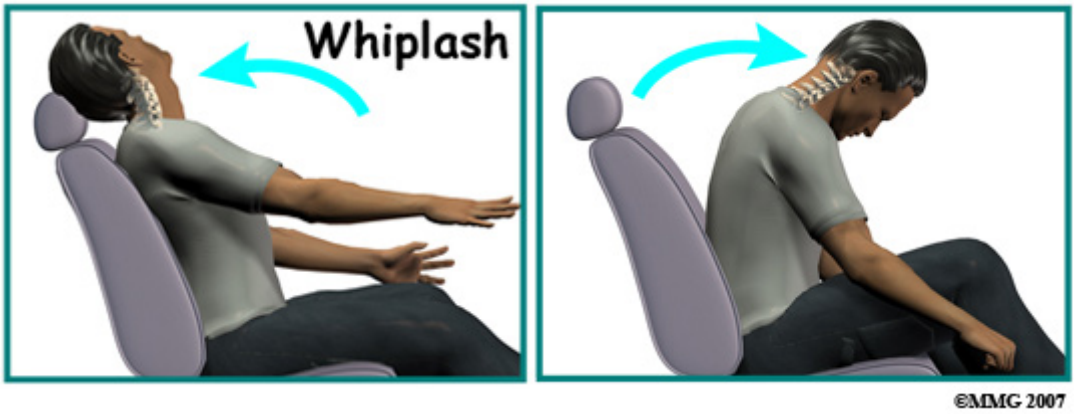
Rautek´s manoeuvre is recommended to move the victim from the danger zone. Head and spine are fixed in a natural axis by a rescuer and protected from extensive flexion, extension or rotation. Head should be in neutral position.



Video 19: Removal from crushed vehicle

11.3.2. Whiplash injury

Mechanism: "cervical acceleration-deceleration" – sudden extension followed by flexion of cervical spine. Result is overextension which can cause tearing of interspinal ligaments (rare), lesion of intervertebral discs, vertebral damage. The most common mechanism is car crash from behind and missing seat headrest.



Picture 60: Whiplash injury (source gallatinvalleychiropractic.com)

Signs and symptoms: Pain, decreased range of motion, and tightness in the neck. The muscles may feel hard. Sometimes the pain of a neck strain is immediate, in other cases it may take several hours to develop.

First aid: in minor problems use cold or ice compression, fixation with neck collar. If problems persist for longer than 2 days suspect a spinal injury and treat likewise.

11.3.3. Spinal injuries with spinal cord injury

Signs and symptoms: as in spinal injury plus signs of spinal cord injury: decreased motoric functions and sensitivity of extremities, loss of function of sphincters of urinary bladder and rectum, penile erection. In case of higher level spinal cord injury, breathing problems (main respiratory muscle –

diaphragm, is innervated from the 4th cervical spinal cord segment), spinal (neurogenic, distributive) shock (see chapter *4 Shock*) and bradycardia may occur.

REMEMBER: spinal shock does not exclude presence of major internal bleeding, just makes sign of haemorrhagic shock more obscure – complex examination of the victim is necessary.

First aid: check vital functions, call EMS, perform anti-shock treatment. In suspected cervical spine injury do not perform extensive back tilt of the head, stabilise spine in axis. Never use stabilised or recovery position in patients with spinal injury.

Notice: in case of spinal cord concussion (similar to brain concussion) spinal cord function should return to normal within 24 hours. In case of spinal cord contusion or disruption – the neurological damage is permanent (in recent state of medical art).

11.3.4. Spinal cord injury without spinal injury

Mechanism: Injury of spinal cord without X ray signs of vertebral column injury is rare. The possible mechanisms are probably shock caused by explosion, overstretching of spinal cord etc.

Signs and symptoms and First aid: as in spinal injuries with spinal cord injury (without X-ray an intact vertebral column can´t be diagnosed).

11.4. Stroke

Cause: Local loss of supply of oxygenated blood. The cause is either obturation of blood vessel (ischaemic brain infarct – 80 %) or rupture of blood vessel – intracerebral bleeding.

History and Signs and symptoms are variable depending on area involved: inability to move or feel on one side of the body, asymmetric face (drop of eyelid, one side of mouth), problems understanding or speaking, dizziness or instability, loss of vision to one side, headache etc.

First aid: Call EMS immediately, control vital functions, in case of lost consciousness treat as an unconscious patient (see above).

11.5. *Seizures, cramps, muscle spasms*

Definition: uncoordinated muscle contractions.

Classification:

- peripheral – muscular problem (metabolism of calcium – tetania, malignant hyperthermia, hypoxia and acidosis – muscle spasms during and after exercise, ischaemic leg disease
- central – CNS disturbance (epilepsy, febrile seizures, eclampsia, rarely ischaemia, infections, tumours)

11.5.1. Muscle spasms and cramps

Cause: metabolic disorder

History: Muscle cramps and spasms can range from being a mild nuisance to incapacitating and extremely painful. The area of a muscle cramp may be firm on palpation. Some muscle cramps last just a few seconds, while others can last 15 minutes or more.

First aid: stretching, massage, warm, hydration, ion drinks with calcium or magnesium

11.5.2. Intermittent claudication

Cause: insufficient supply of oxygenated blood for working muscles

History: Spasms of lower extremity muscles after walking. This interval decreases as disease gets worse.

First aid: rest

NOTICE: Arrange a visit at a doctor. This is not an emergency case

11.5.3. Tetany

Cause: Hyperventilation resulting in decrease of partial pressure of carbon dioxide in blood, decreased plasmatic level of ionised calcium resulting in increased neuromuscular irritability.

History and Signs and symptoms: Panic attacks can cause sweating, palpitations, trembling and difficulty breathing. other signs are hypereflexia – overactive neurological reflexes, carpopedal spasm – spasms of the hands and feet, spasm of facial muscles, cramps, laryngospasm, tingling finger tips, lips, tongue etc.

First aid: Calm the person down and let him breathe from paper bag

11.5.4. Febrile convulsions

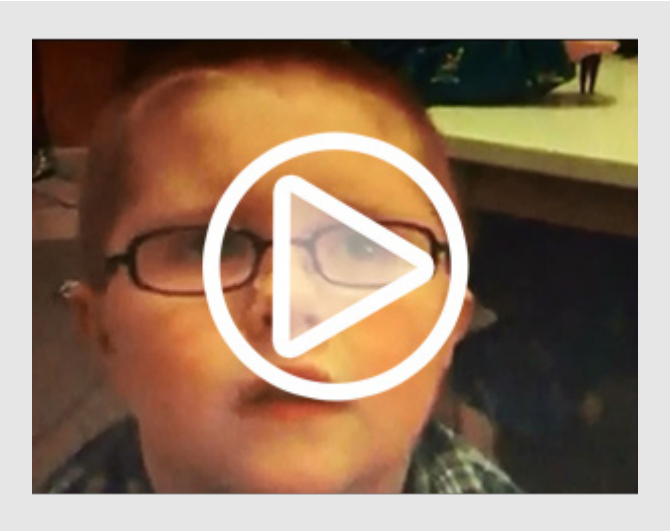
See viz *17 Paediatric emergencies*

11.5.5. Epilepsy

See source *http://www.epilepsysociety.org.uk*

Video 20: Epilepsy – grand mal

Causes: irritation of central nervous system of various origins. There are many types, the best known is grand mal. Absence is typical for children – a child suddenly stops his activity for a while. Amnesia is typical for both forms.



Video 21: Epilepsy – absence

History and Signs and symptoms: Epilepsy is a chronic disease, common triggers of seizures include tiredness, stress, alcohol and not taking medication. Prodromal symptoms are present in some people, so they recognise the coming attack. In others, the seizures come without warning. An epileptic seizure starts with sudden unconsciousness, fall, tonic seizures followed by tonic and clonic seizures often with passing urine and/or stool. Seizures last usually 2 – 3 min, followed by sleep, confusion and finally full recovery.

First aid:

1. Stay calm.
2. Look around – is the person in a dangerous place? If not, don't move them. Move objects like furniture away from them.
3. Note the time the seizures start.
4. Stay with them. If they don't collapse but seem blank or confused, gently guide them away from any danger. Speak quietly and calmly.
5. Cushion their head with something soft if they have collapsed to the ground.
6. Don't hold them down.
7. Don't put anything in their mouth.
8. Check the time again. If a convulsive (shaking) seizure doesn't stop after 5 minutes, call for an ambulance.
9. After the seizure has stopped put them in the recovery position and check if their breathing is returning to normal. Gently check their mouth to see that nothing is blocking their airway such as food or false teeth. If they are having problems breathing after the seizure has stopped, call for an ambulance.
10. Stay with them until they have fully recovered.

Call EMS if:

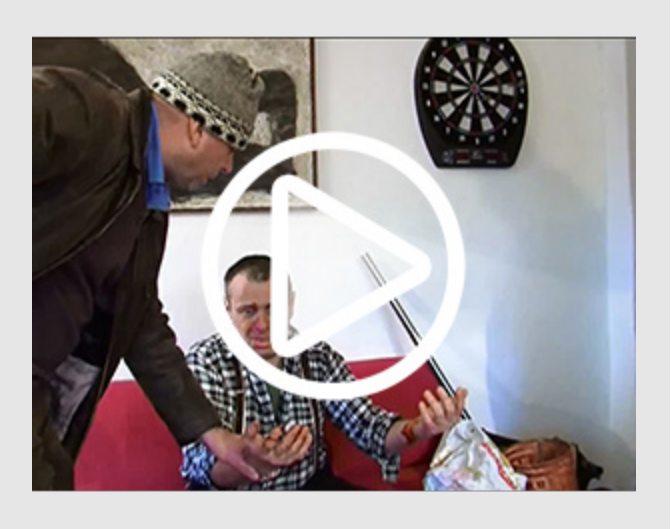
- it is the first attack
- if unconsciousness last for a long period
- convulsions last too long or the attack is different from the previous ones
- epileptic attack resulted in an injury that must be treated

11.6. Acute psychic disorder

Definition: abnormal behaviour

Causes: endogenous (mental illness), intoxications, delirium etc.

Signs and symptoms: vary from changed mood to life-threatening states. Frequently can be seen hallucinations, delusions, disorganised thinking, speech or language that doesn't make sense, unusual behaviour, stress, problems with memory, disorientation or confusion.



Video 22: Acute psychic disorder

First aid: Safety of the rescuer is a priority. Do not approach a aggressive person, keep safe (contact) distance, unless the person is in a serious condition. Always call EMS and Police, obtain history, keep safe distance so you can escape and remove any potential source of danger (knives, weapons, boiling water, glass and sharp objects etc.) Try to get assistance and prefer verbal reassurance.

11.7. CNS infections

Definition: Inflammatory disease of brain or membranes enclosing the brain. From the point of first aid, the most condition is purulent meningitis (see further)

Causes: various pathogens – bacteria, viruses, fungi, parasites.

History: worsening of general health, epilepsy, headache and other neurologic symptoms

11.7.1. Purulent meningitis

Definition: Purulent inflammation of membranes enclosing the brain caused by pyogenic bacteria

Causes: Usually caused by Neisseria meningitides and seen mainly in young people. Infection is airborne, has a rapid progression and sometimes is lethal. Other bacterial agents are Streptococcus pneumoniae, Haemophilus influenzae – mainly in babies and children.

History: sometimes infection of middle ear or non-specific symptoms precede, or the diseases come suddenly without warning.

Signs and symptoms: indicate meningeal irritation: rapid deterioration of status, from full health to unconsciousness, sometimes confusion or aggression, nausea, vomiting, headache, fever over 39 deg C and so called meningeal signs:

- Flexing the patient's neck causes flexion of the patient's hips and knees
- Flexing the patient's hip 90 degrees, then extending the patient's knee causes pain (or extended leg cannot be elevated to 90 degree)
- Nuchal rigidity (neck pain and resistance to flexion)
- Special sign in case of sever meningitis caused by Neisseria meningitides is a blood coagulation disorder. One can observe numerous small, irregular purple or red spots ("petechiae") on the trunk, lower extremities, mucous membranes, conjunctiva, and (occasionally) the palms of the hands or soles of the feet. The rash is typically non-blanching; the redness does not disappear when pressed with a finger or a glass tumbler. There may also be formation of microthrombi which can result in ischemic necrosis of fingers

12. Injuries of eye, nose, ear, mouth, face

12.1. Eye injury

Classification

- burn, acid and alkalic burns – see chapter *18.4 Burns*
- foreign body in eye
- penetrating eye injury
- eye contusion

Burn, acid and alkali burns of and eye

- see chapter *18.5 Chemical burns*

Foreign body in eye

Signs and symptoms: acute pain, foreign body visible on inspection

First aid: If the foreign body is easily accessible and has not penetrated the eyeball, it can be removed carefully with a cotton swab or a tissue or flushed out with clean water. Sometimes eyelid must be everted. It is very important not to rub the eye or to apply any pressure to the eye.

Video 23: Examination of the eye

If there is any question about penetration of the eye, or if the object cannot be removed, cover both eyes and seek medical care.

Penetrating eye injury

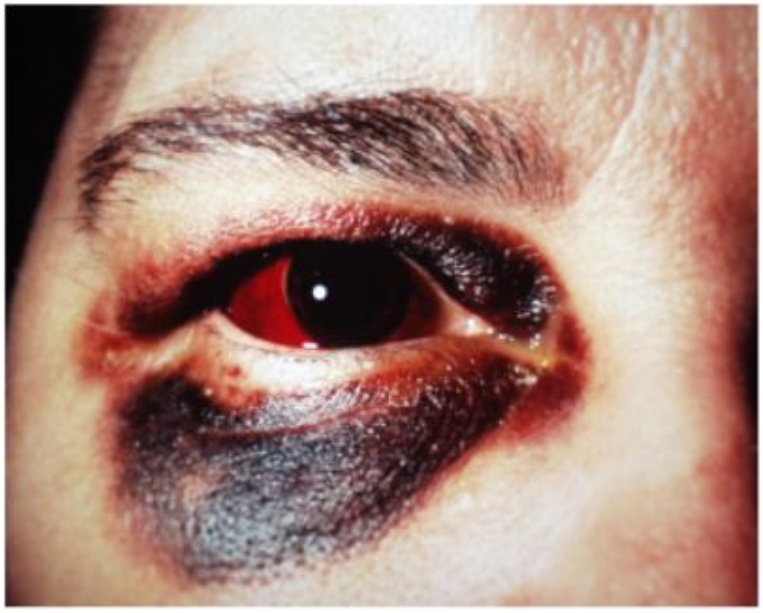
Signs and symptoms: acute pain, sign of injury

Picture 61: Penetrating eye injury (source eyeworld.org, webeye.ophth.uiowa.edu)

First aid: cover both eyes (injured eye with sterile dressing) and refer to an ophthalmologist

Eye contusion

Signs and symptoms: acute pain, sign of injury



Picture 62: Eye contusion (source brooksidepress.org)

First aid: cover **both** eyes (injured eye with sterile dressing) and refer to an ophthalmologist. Do not give anything to eat and drink (treatment will be probably under general anaesthesia)

12.2. Ear injury

Classification

- foreign body
- injury of auricle (external ear)
- bleeding from ear

Ear foreign body

First aid: do not attempt to remove the foreign body that is not easily accessible or removable. Arrange transport to ENT department or to a doctor.

Auricle injury

First aid: sterile dressing, according to extent definitive treatment or arrange transport to surgery (plastic surgery).

Bleeding from ear

CAUTION: if it is not quite clear that the bleeding is from the outer ear canal, think about cranial injury (may be leakage of cerebrospinal fluid with blood in case of a fracture of skull base)

Picture 63: Ear bleeding (source aic.cuhk.edu.hk)

First aid: in case of isolated outer canal bleeding apply sufficient amount of sterile dressing and if necessary arrange transport to ENT department or to a doctor. If you are not sure, treat as a cranial injury

12.3. Nose injury

See chapter *11.2.1.1 Fractures of facial part of a skull*

12.4. Mouth injury

Lip injury

First aid: minor bleeding compress for 10 min, if it does not stop, refer to a doctor. Major injury – see injuries of jaw, teeth and face.

Tooth injury

See chapter *11.2.1.1 Fractures of facial part of a skull*

12.5. Mouth injury

Bleeding, fractures

See chapter *11.2.1.1 Fractures of facial part of a skull*

13. Breathing disturbances (except states necessitating resuscitation)

Classification:

- **Chest injury**
  - Penetrating
  - Blunt
- **Non-trauma causes**
  - disturbance of ventilation (exchange of gas between atmosphere and lungs)
  - disturbance of distribution (distribution of air within the lungs)
  - disturbance of diffusion (movement of gases between the alveoli, plasma, and red blood cells)
  - disturbance of perfusion (movement of blood through the pulmonary capillaries)
  - mixed forms

In this chapter only the most important diseases will be presented

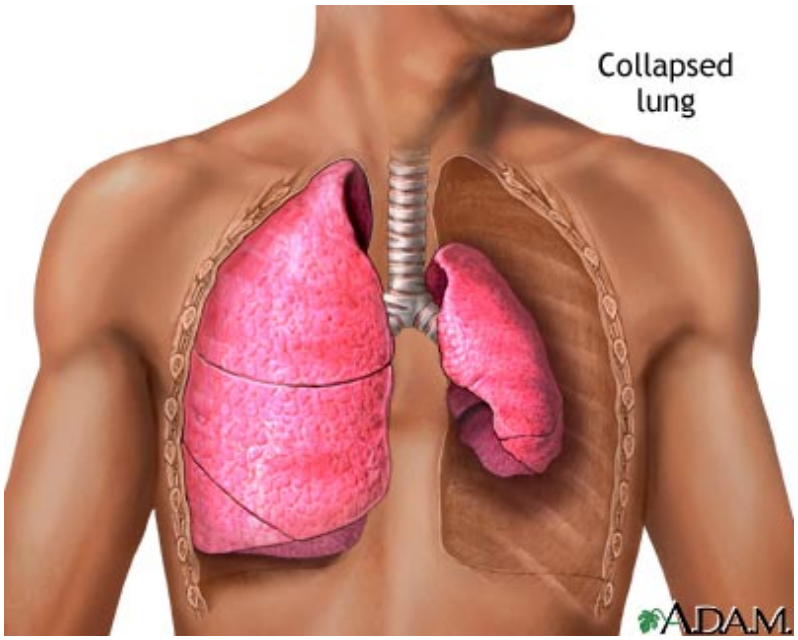
13.1. Loss of mechanical function of chest

Causes:

- injuries of rib cage (serial and block ribs fracture, pneumothorax, injury of diaphragm)
- • nerve injury (CNS and spinal cord injury, intoxications, degenerative and autoimmune diseases)
- muscle disturbances: myasthenia gravis, intoxications, injury and other diseases of diaphragm)

13.1.1. Pneumothorax

Definition: collapsed lung because of loss of negative pressure between two layers of pleura, extra pulmonary air in the chest cavity

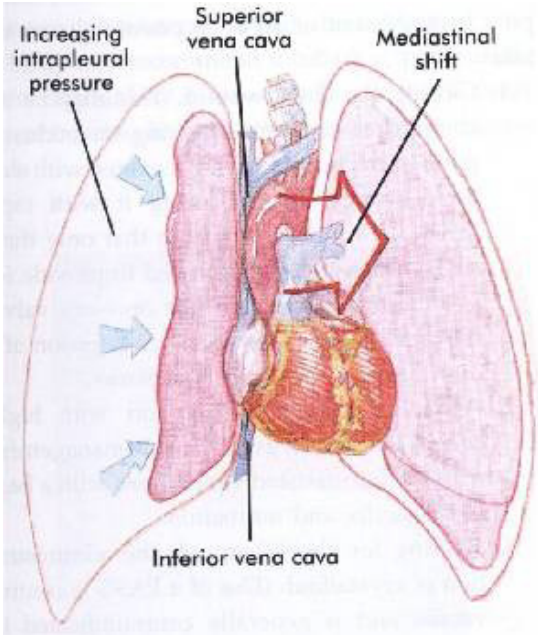


Picture 64: Pneumotorax (source healthcentral.com)

Causes: penetrating chest injury, lung injury by broken rib, blast injury, ruptured pulmonary air blisters (blebs) or some lung diseases

Classification:

- Open (communication between chest cavity and outer atmosphere)
- Closed (pathological communication between chest cavity and lung)
- Tension – tissue in the wound acts as a one-way valve which allows air to enter the pleural space but not to return. Progressive build-up of pressure in the pleural space pushes the mediastinum to the opposite hemithorax, and obstructs venous return to the heart. This leads to circulatory instability and may result in traumatic arrest. The classic signs of a tension pneumothorax are deviation of the trachea away from the side with the tension, a hyperexpanded chest, an increased percussion note and a hyperexpanded chest that moves little with respiration.

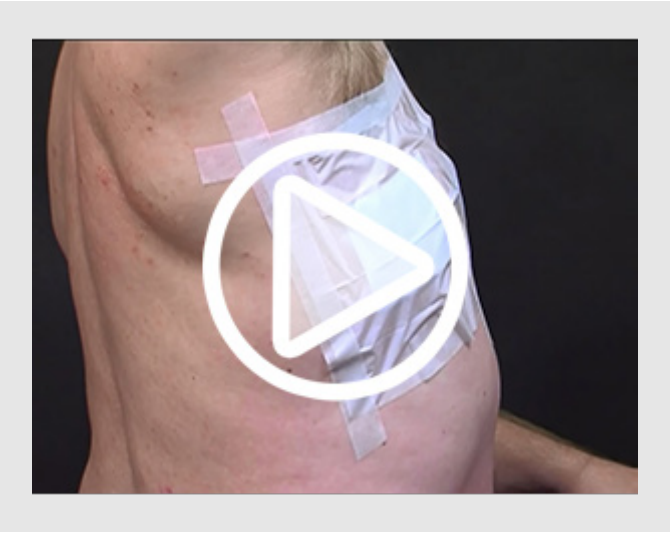


Picture 65: Tension penumothorax (source netsolhost.com)

Signs and symptoms:

- Sharp chest pain, made worse by a deep breath or a cough
- Shortness of breath
- Nasal flaring
- Bluish colour of the skin due to lack of oxygen
- Chest tightness
- Tachycardia
- Tachypnoea
- Hollow sound on percussion and absence of breathing sounds on the site of injury
- Wound with blood with air bubbles in case of open pneumothorax
- In case of tension pneumothorax circulatory collapse

First aid: sitting (orthopnoic) position, call EMS. In case of open pneumothorax put a sterile dressing, a special bandage with plastic foil fixed on 3 sides with adhesive plaster (see *9.2.4 Bandaging of trunk*), monitoring and resuscitation if needed.



Video 24: Pneumotorax – first aid

13.1.2. Fractured ribs

Single fracture is painful, but presents no special problems. Multiple fractures can be divided to

serial fractures – several ribs at the same side are broken at on site. Injury is painful but does not interfere with breathing.

block fractures – several ribs at the same side are broken at 2 sites. Injury may interfere with breathing.

Video 25: Block fractures of ribs

Video 26: Flail chest

Unstable (flail) chest – several ribs are broken in several places, ventilation may be insufficient

Signs and symptoms: pain (more on breathing), dyspnoea, pathological chest movement in case of block fracture and flail chest.

First aid: Assist the patient into a position of greatest comfort, check for any breathing problems, stabilise the fracture site by placing the arm on the affected site into and elevation sling, artificial ventilation or resuscitation if necessary.

13.2. Closed airways

See chapter *17.1 Suffocation*

13.3. Asthmatic attack

Definition: asthma is a chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction and bronchospasm. Common symptoms include wheezing, coughing, chest tightness, and shortness of breath. Asthmatic attack is sudden worsening of previous state

Causes: usually allergy, infection sometimes psychogenic

Signs and symptoms: anything from mild worsening to life threatening situation. Typically severe wheezing when breathing both in and out, coughing, tachypnoea, chest tightness or pressure, difficulty talking, feelings of anxiety or panic, sweating, blue lips or fingernails.

REMEMBER: sudden silence, decreased respiratory rate and bradycardia are signs of imminent cardiac arrest.

First aid: call EMS, help during drugs administration (keep prescribed doses), see *Video 32:*

Video 27: Asthmatick attack

13.4. Pulmonary embolism

Definition: Closure (obstruction) of branch(es) of pulmonary artery by embolus

Causes: Usually part of clotted blood (thrombus), released from deep veins of lower extremity or pelvic venous plexus. Causes of thrombus is ulcer of venous wall, inflammation, increased blood clotting (inherited – thrombophilia, or acquired – use of by contraceptive pills, cancer), decreased velocity of blood flow or blood stasis (pregnancy, cardiac insufficiency, immobilization by splint, after surgery, air flight, long bed rest etc.) Less common cause is fat emboli after long bone fractures.

History: presence of risk factors (see above)

Signs and symptoms: Differs according to extent. Closure of pulmonary artery is fatal. Massive pulmonary embolism (closure of 50 % of pulmonary arterial net presents as acute cardiac failure. Patients have severe dyspnoea and chest pain. Medium size embolism affects usually one middle size branch of pulmonary artery and presents with dyspnoea and chest pain, sometimes with coughing out blood. Closed part of lungs is vulnerable to infection and pneumonia may occur. Successive repeated embolism of small extent may present with exhaustion, tiredness, oedemas of lower extremities.

First aid: Call EMS, person should be sitting or be in a half-sitting position, rest, CPR if necessary (see chapter *6.3.6 Pulmonary embolism* and *Picture 11*)

14. Acute abdomen

Definition: The acute abdomen may be defined generally as an intrabdominal process causing severe pain and often requiring surgical intervention. It is a condition that requires a fairly immediate judgement or decision as to management. General causes of the acute abdomen may be divided into categories:

- **Inflammatory** category of causes may be divided into two subgroups: 1) bacterial 2) chemical. Some common examples of the bacterial causes would include acute appendicitis, diverticulitis, and some cases of pelvic inflammatory disease. An example of a chemical cause would be a perforation of a peptic ulcer, where spillage of acid gastric contents causes an intense peritoneal reaction.
- **Obstructive** causes of an acute abdomen include obstructive conditions such as incarcerated hernia, postoperative adhesions, intussusception, malrotation of the gut with volvulus, congenital atresia or stenosis of the gut. The most common cause of large bowel mechanical obstruction is carcinoma of the colon. Vascular entities producing an acute abdomen include mesenteric arterial thrombosis or embolism. When the blood supply is cut off, necrosis of tissue results with gangrene of the bowel. Neurogenic bowel is characterised by bowel paralysis. The most common cause is surgery of spinal cord.
- **Bleeding** e.g. from perforated ulcer or cancer.
- **Traumatic** causes of an acute abdomen range from stab and gunshot wounds to blunt abdominal injuries producing conditions such as splenic rupture. History or evidence of trauma should make this diagnosis fairly obvious.
    - closed injuries
    - open injuries

Signs and symptoms:

- Subjective
    - pain
    - vomiting
    - loss of bowel opening
    - hiccup
    - diarrhoea
- Objective
    - systemic (fatigue, malaise, fever, bleeding etc.)
    - local (injury, abdominal wall stiffening)

First aid: Although definitive therapy and diagnosis are very difficult for a surgeon, first aid is usually quite simple.

- Recognise acute abdomen, if not sure act as in acute abdomen.
- According to general state, arrange transport to surgery (minor symptoms) or call EMS
- Give nothing to eat or drink, no medicines and drugs.

- In case of injury put a sterile dressing to contain any foreign body and abdominal cavity contents. Internal bleeding – see chapter *4.1 Hypovolemic shock*
- Relief or anti-shock position
- Monitor the patient until EMS arrives or transferring to medical care

Risks: some complications may be fatal. The most common mistakes are:

- Underestimating of patients 'complaints
- Insufficient examination
- Underestimation of signs and symptoms
- Insufficient knowledge
- Overestimation of rescuer knowledge and skills
- Lack of control
- Administration of drugs (antibiotics, analgesics, corticosteroids, laxatives)
- Late medical care
- Eating and drinking
- Alcohol
- Use of cold or ice
- Dissimulation

15. Acute medical problems in pregnancy

Obstetrics presents an extensive medical speciality. Only the most important problems will be mentioned in this chapter. Health problems connected with pregnancy are classified as early (in the beginning of gravidity) or late. Out of hospital births will also be presented, although this is not an illness or pathological state.

15.1. Severe nausea and vomiting during pregnancy – hyperemesis gravidarum

Definition: vomiting more than 3 – 4 times in a day, weight loss, dizziness, and dehydration during the first 3 months of pregnancy.

Causes: not known

Signs and symptoms: nausea and vomiting are frequent during beginning of pregnancy, but if excessive with dehydration presents a pathological problem. In extremes lethargy, fainting, jaundice, loss of urine production and signs of hypovolemic shock (see chapter *4 Shock*) may be present.

First aid: refer to a doctor; do not try to treat by yourself.

15.2. Abortion (spontaneous, miscarriage)

Definition: unintentional expulsion of an embryo from uterus before the 24th week of pregnancy.

Causes: chromosomal, infections, intoxications, etc.

Signs and symptoms: in imminent abortion mainly pain in lower abdomen, in incomplete abortion bleeding, which may be severe and in complete abortion expulsion of embryo or foetus

First aid: as in other bleeding problems, medical (gynaecological) treatment is necessary

15.3. Extrauterine (ectopic) pregnancy

Definition: A situation when a fertilized egg settles and grows in any location other than the uterus, mainly in the Fallopian tube (95 %) but also in the ovary, cervix, and abdominal cavity. During placental growth, vessels may be eroded, and severe internal bleeding may occur.

Causes: various, like pelvic inflammatory disease, tube irregularities, previous surgeries etc.

Signs and symptoms: hypogastric pain, sometimes pain in left shoulder (irritation of diaphragm by blood), shock after rupture.

First aid: Call EMS, anti-shock treatment. Must be treated surgically.

15.4. Placenta praevia

Definition: Implantation of fertilised egg in the lower part of the uterus and the placenta later develops in the cervix uteri (so called placenta praevia). During birth the placenta is expelled before the foetus is born. This can lead to serious haemorrhages. For this reason, a caesarean section is always used for enabling births in such situations. Placenta praevia occurs in 1% of all pregnancies and is usually diagnosed by sonography during regular obstetric controls.

Signs and symptoms: Contractions during placental separation or feeling of tenderness in lower abdomen, bleeding.

First aid: Call EMS, treatment as in shock, anti-shock position on left side.

15.5. Preeclampsia and eclampsia

(source *http://lekari.porodnice.cz/preeklampsie-eklampsie-0*)

Definition: preeclampsia is a complication of the second half of pregnancy, often in the latter part of the second or in the third trimesters. Pregnant women develop high blood pressure (over 140/90 mm Hg, high level of protein in the urine, swelling in the feet, legs, and hands. If untreated or undiagnosed, preeclampsia can lead to eclampsia, a life-threatening condition with seizures.

Causes: not known, probably immunological, partly hereditary.

Signs and symptoms: appear usually in the 3rd trimester of pregnancy: sudden and new swelling in ace, hands, and eyes (some feet and ankle swelling is normal during pregnancy), blood pressure greater than 140/90, sudden weight gain over 1 or 2 days, abdominal pain, especially in the upper right side, severe headaches, a decrease in urine, blurry vision, flashing lights, and floaters. Seizures in case of eclampsia.

First aid: Call EMS. Eliminate external stimuli (noise, light etc.) which may provoke seizures.

15.6. Resuscitation of a pregnant

Same as in non-pregnant with only one difference. After 2nd trimester: resuscitate in 15 degrees left side lateral position. The reason is to decrease compression of the inferior vena cava and aorta by heavy uterus. So called aortocaval compression decreases venous return. Caesarean section should be performed as soon as possible.

15.7. Out-of-hospital births

(source *http://www.babycenter.com*)

Video 28: First aid in childbirth.
See also ***https://www.youtube.com/watch?v=-cnGKVskrdM***

It's uncommon for babies to be born without warning. Only about one in 200 babies are born suddenly, usually at home. Normal term of delivery is 38th – 40th week of pregnancy. Delivery is divided into 3 stages. Before delivery, some signs appear. Mucus plug that has sealed cervical canal comes out in a lump with some blood or as increased vaginal discharge. This may precede delivery by several days. When regular contractions start and water breaks (rupture of fluid-filled amniotic sac surrounding a foetus), labour usually follows soon.

- **The first stage (opening phase)** begins with contractions that cause progressive changes in cervix and ends when cervix is fully dilated. This stage is divided into two phases:
    - Early labour: cervix gradually effaces (thins out) and dilates (opens).
    - Active labour: cervix begins to dilate more rapidly, and contractions are longer, stronger, and closer together. Rupture of amniotic sac may appear during this stage.
- **The second stage of labour (pushing phase)** begins when cervix is fully dilated and ends with the birth of baby. Contractions last 2 – 4 minutes
- **The third stage** is delivery of the placenta.

Every pregnancy is different, and there's a wide variation in the duration of labour. Labour in first pregnancy often takes between 10 and 20 hours. For some women though it lasts much longer, while for others it's over much sooner. Labour generally progresses more quickly for women who've already given birth vaginally.

First aid: Always call EMS or a family obstetrician for help. Try to get history about duration of pregnancy, possible complications, information about contractions (when they started, regularity, frequency, intensity, duration)

The first stage (duration in first pregnancy 10 – 12 h, second pregnancy 6 – 8 h.)

No special activity is required. Find a place with sufficient privacy that is clean and warm. Any comfortable position or walking is possible. Remove all clothes below waist. If contractions are more and more frequent assist the mother into a position of greatest comfort. Try to protect yourself (stay on side of the mother to avoid coming in contact with blood and amniotic water) and the mother (use sterile first aid kit or disinfect aids using boiling water – strings, dressings, scissors). Blankets should be as clean as possible.

For delivery you may need (*http://www.wikihow.com/Deliver-a-Baby*):

- Sterile gloves if possible (from the first aid kit)
- Clean towels and clean sheets. Clean waterproof tablecloths or a clean vinyl shower curtain are excellent at preventing blood and other fluids from staining furniture or carpeting. Improvised aid is fresh newspapers.
- Blanket or something warm and soft to wrap the baby in. The infant must be kept warm once it's delivered.
- Fill a clean bowl with warm water
- A pair of scissors, 3 pieces of string (0.5 cm wide, sufficiently long for making safe knots), rubbing alcohol, cotton balls
- Sanitary napkins or paper towels are helpful to stop the bleeding later.

Second stage (duration in first-term pregnancy 10 – 20 min, other 5 – 10 min)

- Don't encourage the mother to push until she feels an unstoppable pressure to do so. When women are ready to push, they may feel increased pressure near their low back, perineum, or rectum. It may even feel to her as though she is ready to have a bowel movement. When pushing, it can be helpful if the mother holds her knees or legs with her hands and pulls her legs back.
- The area around the vagina will bulge out, until the top of the baby's head (crowning) is seen. As soon as the baby crowns, it's time for the mother to push in earnest.
- Encourage her to push gently between contractions. She'll want to push hard at the peak of a contraction, but this isn't ideal. Instead, instruct her to exhale through her mouth when a contraction is most intense, and start to push as soon as the contraction eases. Encourage her to focus her abdominal muscles to push down, as you might do when you're trying to make your urine come out faster. This can help avoid straining or directing the pushing force upward toward the neck and face. Three to four pushes, lasting 6-8 seconds each, are considered appropriate per contraction. However, it is important to encourage the mother to do whatever comes naturally to her.
- Do not pull on the baby's head or the umbilical cord. This can cause nerve damage. If the cord is wrapped around the baby's neck, gently lift it over the baby's head or carefully loosen it so the baby can slip through the loop. Do not pull on the cord.
- The baby usually passes through the pelvis face-down. When the baby's head rotates to one side, be prepared for the body to come out with the next push. First a shoulder emerges with the next push. Deliver the other shoulder. Gently lift the body toward the mother's stomach to help the other shoulder come through. The rest of the body should follow quickly.
- Keep supporting the head. The body will be slippery. Make sure you're still providing enough support for the baby's neck, which isn't strong enough to support the head on its own. Hold the baby so the fluids in its mouth and nose drain. Hold the delivered baby with two hands, one supporting its neck and head. Tilt the head down at about a 45-degree angle to allow the fluids to drain. The feet should be slightly above the head (but don't hold the baby by the feet). You can also wipe any mucus or amniotic fluid from the nose and mouth area with clean, sterile gauze or cloth.
- Place the baby on the mother's chest. Ensure full-skin contact, and cover them both with clean towels or blankets. The skin-to-skin contact encourages a hormone called oxytocin, which will help the mother deliver the placenta. Position the baby so that its head is still slightly lower than the rest of the body, so fluids can keep draining. If the mother is lying down and the baby's head is on her shoulder and its body is on her breast, this should happen naturally.
- The baby should cry soon. If not try to wipe fluids out of the mouth and nose with a clean blanket or cloth and manually stimulate him. If it still does not work, start resuscitation (see further).
- Decide whether to cut the cord. You should only cut the umbilical cord if professional medical attention is long away. Otherwise, leave it alone and just make sure it's not pulled tight.

- If you do need to cut the cord, first feel the cord gently for a pulse. After about ten minutes, the cord will stop pulsing because the placenta has separated. Don't cut it before then. Tie a string or lace around the cord, about three inches from the baby's belly button. Tie it tightly with a double knot. Tie another lace about 5 – 7 cm away from the first one, again using a double knot. You may use a third one (to augment safety) 5 cm from the second one. Using a sterile knife or scissors (that have been boiled in water for 20 minutes or wiped down with rubbing alcohol), cut between the two laces (if three are used, two remain at the child). Don't be surprised if it's rubbery and tough to cut; just take your time. Cover the stump with sterile dressing.
- Cover the baby again when the cord is cut.
- In any other part than the head of a newborn appears in birth canal, call EMS for further advice.

Third stage (10 – 30, sometimes up to 60 min)

Delivering the placenta is the third stage of labour. It will arrive anywhere between a few minutes to an hour after the baby is delivered. **Don't pull on the umbilical cord**. As the placenta is delivering, don't tug on the cord to hurry it along. Let it come out on its own as the mother pushes, pulling on it could cause severe damage. The mother will probably feel an urge to push after a few minutes; this is helpful. Put a bowl close to the vagina. Right before it emerges, blood will come out of the vagina and the cord will get longer. Have the mother sit up and push the placenta into the bowl. Once the placenta is out, place it in a trash bag or a container with a lid. When and if the mother goes to a hospital, the doctor might want to inspect the placenta for any abnormalities.

After delivery, keep the mother and baby warm and comfortable. Cover them both in blankets, and encourage the mother to keep the baby on her chest. Replace any wet or dirty bedding and move them to a clean, dry area.

REMEMBER temperature control. Naked, wet newborn babies cannot maintain their body temperature in a room that feels comfortably warm for adults. Dry the baby immediately after delivery. Cover the head and body of the baby, apart from the face with a warm towel to prevent further heat loss. Alternatively, place the baby skin to skin with mother and cover both with a towel. In preterm babies (especially below 28 weeks) drying and wrapping may not be sufficient. A more effective method of keeping these babies warm is to cover the head and body of the baby (apart from the face) with plastic wrapping, without drying the baby beforehand.

15.8. Resuscitation of a newborn

(source http://www.erc.edu/)

Video 29: Resuscitation of a newborn

Apgar scale is used for evaluating the newborn baby in 1st, 5th and 10th min. after delivery. Although it is named by Canadian anaesthetist Virginia Apgar, her name can be used as acronym for five simple criteria (Appearance, Pulse, Grimace, Activity, Respiration), each scored 0 – 2 points.

- **Appearance** (blue or pale all over – blue only extremities, body pink –completely pink, no cyanosis)
- **Pulse** (absent = 0, below 100/min = 1, over 100/min = 2)
- **Grimace** (no response to stimulation – flaccid, some flexion of extremities – active motion, pulls away) (no response to stimulation – grimace on suction or pain – cry)
- **Activity** (
- **Respiration** (absent – slow irregular – regular, vigorous cry)

Relatively few babies need any resuscitation at birth. Of those that do need help, the overwhelming majority will require only assisted lung ventilation. A small minority may need a brief period of chest compressions in addition to lung aeration.

Start with stimulation. Drying the baby usually produces enough stimulation to induce effective breathing. Avoid more vigorous methods of stimulation. If the baby fails to establish spontaneous and effective breaths following a brief period of stimulation, further support will be required. Place the baby on his or her back with the head in a neutral position. A 2cm thickness of the blanket or towel placed under the baby's shoulder may be helpful in maintaining proper head position. Suction is needed only if the airway is obstructed. Start with ventilation first, open the airway and give 5 inflation breaths. For the first five inflations maintain the initial inflation pressure for 2–3 s, this will help lung expansion. Reassess. If there is no chest movements or if heart rate is below 60, start chest compressions. The most effective technique for providing chest compressions is to place the two thumbs side by side over the lower third of the sternum just below an imaginary line joining the nipples, with the fingers encircling the torso and supporting the back. The sternum is compressed to a depth of approximately one-third of the anterior–posterior diameter of the chest allowing the chest wall to return to its relaxed position between compressions. Use a ratio of three compressions to one ventilation, aiming to achieve approximately 120 events per minute, i.e. approximately 90 compressions and 30 ventilations. Reassess frequently for signs of life.

15.9. Lactic psychosis

Definition: psychic disorder and abnormal behaviour connected to puerperium

Causes: unknown

History and Signs and symptoms: depression after delivery, in severe cases acute psychosis with hallucinations. May be risk of murder of injury of a child.

First aid: look after safety of mother and child, call EMS

15.10. Mastitis (inflammation of a breast)

Definition: bacterial infection of the breast.

Causes: bacterial infection during incomplete breast emptying, retention of milk etc. (wrong technique of breastfeeding, pressure on breasts, breast injury, fissure in nipples). Inflammation is usually only in part of one breast, less frequently in the whole breast or both breasts.

Signs and symptoms: Breast is swollen, infected part is hot, red, and very painful. The woman has flu-like symptoms: fever, chills, shivering.

Picture 66: Mastitis (source mayoclinic.com)

First aid: Improve breast emptying (more frequent breastfeeding, changing of positions during feeding, proper feeding technique, suctioning of remaining milk). Paracetamol or ibuprofen can be used for pain relief and against inflammation. If the problem does not improve within 24 hours or if symptoms are severe, recommend the women to see her doctor.

16. Acute gynaecological emergencies without connection with pregnancy

First aid is similar as in other emergencies, e.g. injuries, acute abdomen etc. Gynaecological bleeding should be treated according to extent either by own transport to gynaecology or as other serious bleeding (see chapter *5 Bleeding*).

17. Paediatric emergencies

Many emergencies in children present as the same problems in adults. The main differences are more rapid onset (children has lower physiological reserves) and rapid worsening (lower compensating mechanisms). Some diseases are typical for paediatric group: the most dangerous are presented in the chapter.

17.1. Suffocation

Definition: insufficiency of respiratory system

Causes: depend on site of disturbances. There may be an obstacle in upper airways (epiglottitis, laryngitis, foreign body aspiration) or in lower airways (asthma, bronchiolitis, pneumonia), less frequently pneumothorax, injury etc. (see chapter *13 Breathing disturbances (except states necessitating resuscitation)*).

Signs and symptoms:

11. increased respiratory frequency (in newborns and infants > 50/min, in children 1 – 6 y. > 25 min, older children > 20/min
12. breathing through open mouth
13. abnormal sounds during breathing (stridor, wheezing, high pitching noises, barking cough)
14. retraction of soft parts of chest and throat, in small children moving of nostrils during breathing
15. typical position (sitting in epiglottitis, orthopnoea in asthma)
16. cyanosis

REMEMBER: sudden calming or lethargy of suffocating child is warning sign of critical asphyxia

17.1.1. Acute epiglottitis

Definition: Acute viral inflammation of epiglottis and surrounding tissues which may result in suffocation from larynx obstruction by swollen epiglottis.

Signs and symptoms: Usually in children aged 6 months – 5 years with fever up to 40 °C, sitting and refusing to lie down because he/she has problems to breathe. Due to the pain during swallowing they have excessive salivation, limited cough, anxiety or lethargy pain. Bubbling sounds during inspiration.

First aid:

- Immediately call EMS
- Make sure the child is close to the mother (calming, decrease of ventilator effort)
- Cold air (put in front of refrigerator or open window if it is a freezing day).

REMEMBER: never put the child in a supine position.

17.1.2. Acute laryngitis

Definition: Acute viral inflammation of larynx, typically during October to May. Risk group are children aged 6 months – 5 years, where inflammation can cause laryngeal oedema and asphyxia.

Signs and symptoms: Onset usually at night, difficulties in breathing, stridor on inspiration, hoarse barky cough, mild fever, restlessness, no effect of position of the child. Worsening is signalised by moving of nostrils during breathing, strangulation in abdomen at the site of diaphragm, bluish discolouration of the skin or lips, sucking in of the chest, lethargy.

First aid: Immediately call EMS, keep close to the mother (calming, decrease of ventilator effort), cold air (put in front of refrigerator or open window if it is a freezing day).

17.1.3. Foreign body aspiration (choking)

Definition: Semi complete or complete obstruction of the airway by a foreign body. The most critical part of the airway is larynx (between vocal cords in adults and just behind them in babies).

Signs and symptoms: cyanosis, panic, either sudden cough (better) or impossibility to breathe and cough, chocking, victim may clutch his neck

First aid: In incomplete obstruction (ability to speak, breathe and cough) only encourage to cough. In complete obstruction: back blows, chest thrusts and abdominal thrusts – Heimlich manoeuvre (should not be performed in babies and small children) all increase intrathoracic pressure and can expel foreign bodies from the airway. If the victim is already unconscious, try to give 5 breaths and start resuscitation. Call EMS immediately

Video 30: Foreign body airway obstruction

17.1.4. Allergic oedema of upper airways

Definition: Rapid onset of swelling of tongue, hypopharynx and larynx caused by severe allergic reaction.

Signs and symptoms: History of allergy (REMEMBER, this may be the first allergic reaction!), may be insect bite, local disturbances of sensations (pins and needles etc.), swelling, difficulty speaking, breathing, redness, skin reaction, generalised signs of allergy (see chapter *4.6 Anaphylactic shock*).

First aid: Call EMS immediately. Before arrival, monitor the patient and reassure him. Oedema can be decreased by applying cold dressing or sucking ice. Some people have been already equipped with an autoinjector with adrenaline (e.g. EpiPen, Anapen), which must be applied as soon as possible to outer upper third of thigh. Act according to pictures on the device (see *Picture 12: EpiPen*, *Video 31: How to use EpiPen*). Following medical first aid consists of administration of adrenaline (s.c., i.m., i.v.), corticosteroids, infusions etc. If treatment starts early, prognosis is good.

Video 31: How to use EpiPen

REMEMBER: Even after successful EpiPen administration, patient must be admitted to a hospital for 24 hours, anaphylaxis may reappear after several hours.

17.1.5. Asthmatic attack

(see also *13.3 Asthmatic attack*)

Definition: asthma is a chronic inflammatory disease of the airways characterized by variable and recurring symptoms, reversible airflow obstruction and bronchospasm. Common symptoms include wheezing, coughing, chest tightness, and shortness of breath. Asthmatic attack is sudden worsening of previous state

Causes: usually allergy, infection sometimes psychogenic

Signs and symptoms: anything from mild worsening to life threatening situation. Typically severe wheezing when breathing both in and out, coughing, tachypnoea, chest tightness or pressure, difficulty talking, feelings of anxiety or panic, sweating, blue lips or fingernails. REMEMBER: sudden silence, decreased respiratory rate and bradycardia are signs of imminent cardiac arrest.

First aid: call EMS, help during drugs administration (keep prescribed doses)

Video 32: Inhalation (spacer)

17.2. Febrile seizures

(source *http://www.ninds.nih.gov/disorders/febrile_seizures/detail_febrile_seizures.htm*)

Definition: convulsions brought on by a fever in infants or small children usually between 3 – 5 years.

Signs and symptoms: fever over 39 deg. C, unconsciousness and convulsions on both sides of the body. Less commonly, the child becomes rigid or has twitches in only a portion of the body, such as an arm or a leg, or on the right or the left side only. Most febrile seizures last a minute or two, although some can be as brief as a few seconds while others last for more than 15 minutes.

First aid: To prevent accidental injury, the child should be placed on a protected surface such as the floor or ground. The child should not be held or restrained during a convulsion. To prevent choking, the child should be placed on his or her side or stomach. When possible, gently remove any objects from the child's mouth. Never place anything in the child's mouth during a convulsion. Decrease body temperature (rectal paracetamol, ibuprofen) or cold dressing. Look at your watch when the seizure starts. If the seizure lasts 10 minutes, the child should be taken immediately to the nearest medical facility. Once the seizure has ended, the child should be taken to his or her doctor to check for the source of the

fever. This is especially urgent if the child shows symptoms of stiff neck, extreme lethargy, or abundant vomiting.

Children especially prone to febrile seizures may be treated with the drug diazepam orally or rectally, whenever they have a fever. Rectal diazepam is provided by a doctor.

REMEMBER: acetylsalicylic acid (like Acylpyrin, Aspirin etc.) must be never given to babies and children!

NOTICE: the vast majority of febrile seizures are short and harmless. During a seizure, there is a small chance that the child may be injured by falling or may choke from food or saliva in the mouth. there is no connection between febrile seizures and epilepsy.

18. Environmental factors injuries

18.1. Hypothermia

Source *http://bestpractice.bmj.com/best-practice/monograph/654/basics/classification.html*

Definition: decreased core body temperature below 35 deg Celsius. Core consists of organs of abdominal, thoracic and cranial cavities with constant temperature 37 deg. C under normal conditions. Peripheral parts – extremities, face, sacral body parts usually participate on thermoregulation. Heat is produced in liver and in muscles, heat loss is by evaporation.

Causes: loss of thermoregulation because of low temperature in surrounding environment.

History: cool weather, strong wind, insufficient physical activity or clothes, alcohol intake

Signs and symptoms according to degree:

1. **Mild hypothermia**
   - Core temperature of 32°C to 35°C (90°F to 95°F).
   - Tachycardia, shivering, vasoconstriction, and tachypnoea.
2. **Moderate hypothermia**
   - Core temperature of 28°C to 32°C (82°F to 90°F).
   - Loss of shivering.
   - Marked by cold-induced cardiac arrhythmias (bradycardia, bradyarrhytmias)
   - Hypotension
   - Respiratory depression
   - Pupil dilation
   - Reduced gag reflex
   - Hyporeflexia
   - With time, patients develop fatigue, ataxia and become apathetic. Impaired judgment will also occur
3. **Severe hypothermia**
   - Core temperature of <28°C (<82°F)
   - Coma
   - Apnoea
   - Fixed dilated non-reactive pupils
   - Ventricular arrhythmias or asystole
   - Pulmonary oedema
   - Loss of all vital functions

First aid

Always: Prevent further warm loss, protect from cold, insulate, cover, in severe cases call EMS.

If a victim is conscious and communicates, give warm drinks, food, encourage physical activity, use warm bath, blankets etc.

In mild decreased level of consciousness give nothing by mouth (risk of aspiration), use passive rewarming.

In unconscious victim call EMS, transport, avoid unnecessary movement (see further), monitor vital functions, resuscitation if needed. “No hypothermic patient is dead unless is warmed and still dead!”. Do not move extremities.

Risks

Be careful not to produce burns or scalding during aggressive rewarming. Do not manipulate with a victim with 3rd degree hypothermia. You can mix very cold blood in extremities with warmer blood in core thus causing a lower core temperature. Rewarming is done in a hospital by extracorporal

18.2. Hyperthermia (heat stroke)

see also *http://www.medicalnewstoday.com/articles/266551.php*

Definition: elevated body temperature (over 37.5 – 38.5 depending on definitions) due to failed thermoregulation.

Causes: Failed thermoregulation. Commonly caused by prolonged exposure to excessive heat, high humidity and rarely by some drugs.

History: Been in a hot and humid environment.

Signs and symptoms: Weakness, decreased activity, increased heart rate, breathing, high temperature, hot skin, ineffective sweating. When the body cannot sweat any more, as may happen in cases of severe dehydration, the skin will become dry. Other signs are nausea, vomiting, headache, in severe cases fainting or dizziness, seizures because of mineral loss and unconsciousness.

First aid: First remove the victim from hot environment to a cool area and remove clothing. Use ice packs with ice in groins, neck, cold dressings or cool bath. If the person is conscious give isotonic drinks, mineral water etc.

REMEMBER: cooling should not be unpleasant to the victim.

18.3. Sun stroke

Definition: elevated body temperature because of prolonged sun exposure

Causes: as heat stroke, more over CNS irritation

History: been outside in the sun in hot days without using any protective measures.

Signs and symptoms: as in heat stroke, more frequently headache, nausea, vomiting. Heat stroke may appear after several hours of exposure

First aid: as in heat stroke, predominantly cool head. Use paracetamol for headache.

18.4. Burns

(source *http://www.healthline.com/health/burns#Overview1*)

Definition: a traumatic injury to the skin or other organic tissue primarily caused by thermal or other acute exposures. Bearable contact temperature is 43.5 °C. Skin injury starts at 55 °C, denaturation of proteins at 60 °C. Next important factor is time of exposure: (temperature 53 °C causes skin damage in 60 s, temperature 55 °C in 30 s).

Classification:

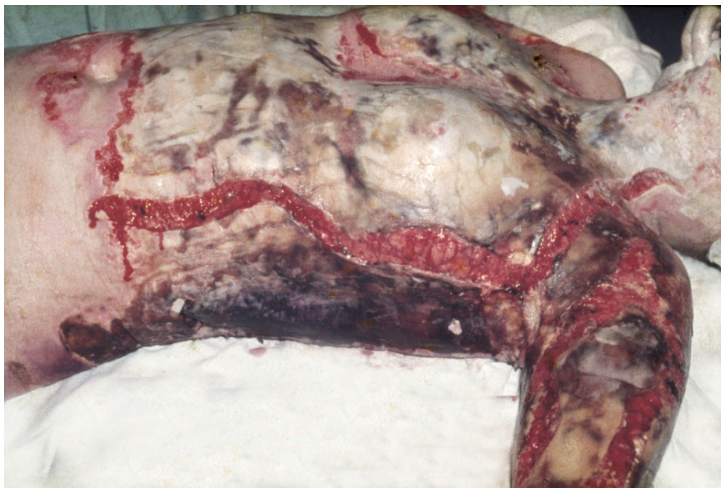
- **First degree**: Includes only the outer layer of skin, the epidermis. Skin is usually red and very painful, equivalent to superficial sunburn without blisters. Burn is dry in appearance, healing occurs in 3-5 days, injured epithelium peels away from the healthy skin
- **Second degree** involves 2 grades
    - Partial-thickness burns involves epidermis and superficial portion of the dermis. Blisters are frequent, wound is pink, red in colour, painful and wet appearing, blanches with pressure, painful. Heals without grafting
    - Deep partial-thickness burns (former 2nd B degree burn) involves the epidermis and most of the dermis, appears white or poorly vascularized, blanching is sluggish or absent; may not blister, less pain, frequently excision of the wound and skin grafting is necessary
- **Third degree**: Involves epidermis and all layers of dermis, extending down to subcutaneous tissue. Appears dry, leathery, and insensate, often without blisters, can be difficult to differentiate from deep partial-thickness burns and needs skin grafting to heal.
- **Fourth degree** burns involve thermal injury extending to muscles and bones.

Picture 67: Burns 1st degree isolated (source tubeautify.files.wordpress.com)

Picture 69: Burns 1st degree extensive (source i.telegraph.co.uk)

Picture 68: Burns 2nd degree isolated (source ppp.zshk.cz)

Picture 70: Burns 2nd degree extensive



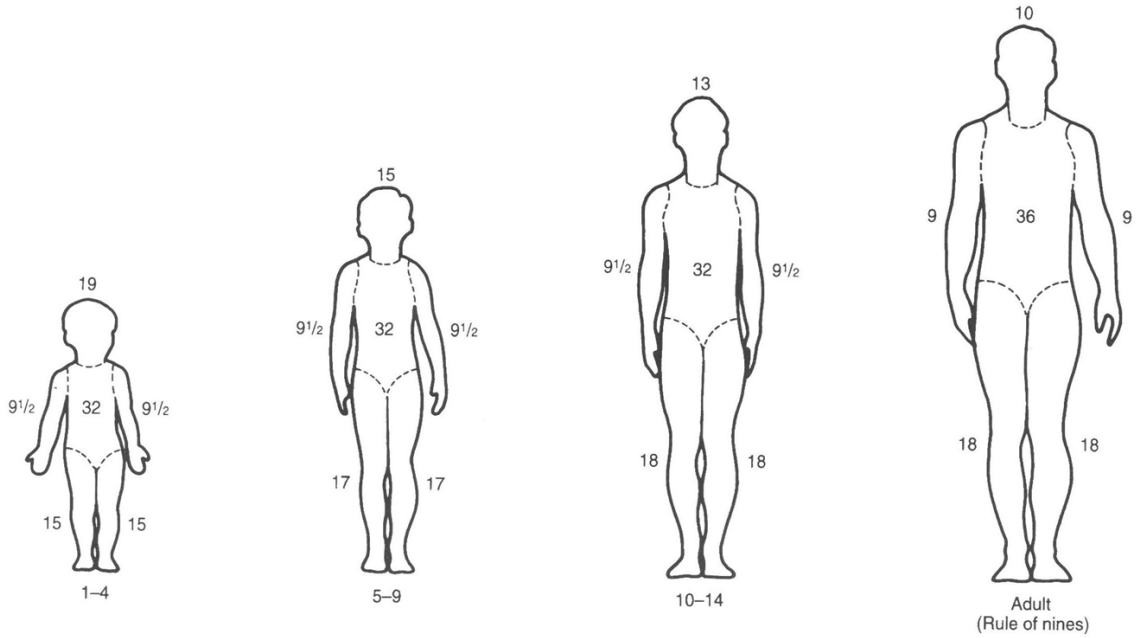
Picture 71: Burns 3rd degree

Extent:

There are various methods how to calculate the extent of surface of the injury. In adults, rule of 9 is used frequently, but cannot be used on children for different body scale (surface are of 1 y old baby is 17 %, in an adult 9 %).

Rule of 9:

Head 9 %, upper extremities 2 x 9 %, lower extremities 2 x 18 %, trunk 2 x 18 %, genitals 1 %. In infants up to 2 years the surface area of a patient's hand represents 1 % of body surface. Alternatively tables can be used.



Picture 72: Body surface area

Critical burns

5 % and more in children up to 2 years
10 % and more in children up to 10 years
15 % and more in children up to 15 years
20 % and more in children older than years .

Added risk factors:

- Age (too young or too old)
- Complicating diseases
- Burns of face, hand, foot, genitals, buttocks
- Inhalation trauma, circular wound risk of oedema and compartment syndrome (compression of blood vessels because of oedema in limited space among firm membranes).

Every severe burn trauma should be treated in a specialized centre.

Burn shock is combination of distributive and hypovolemic shock (fluid and protein loss from the vascular space, loss of vessel wall integrity, impaired myocardial contractility)

First aid:

Stop the burning process (clothes caught on fire), cover, roll the person and cover the face to protect the airway. Prevent any strain, running etc. Remove any clothes soaked with hot fluid. Do not remove parts that firmly adhere to the skin.

Cool with clean running water 8 °C for about 20 min or until pleasant but only small areas. Prolonged cooling of large surfaces results in hypothermia, decreased skin perfusion and worsening of the wound. Always cool:

a) face
b) neck
c) hands
d) feet
e) minor burns

Remove rings, piercing and all accessories that could not be removed in case of swelling
Cover: use a clean dressing or plastic cling foil to cover the burn
Keep the patient warm
Do not give anything to eat or drink

The most common mistakes:

4. Cooling of the whole body, patient develops hypothermia
5. Cooling with ice
6. Use of ointments and other similar remedies
7. Underestimation of the injury
8. Oral intake of food, drink, drugs etc. Treatment is done usually in general anaesthesia and oral intake increases risk of aspiration of gastric content into lungs

18.5. Chemical burns

Definition: injury by substances causing chemical necrosis of skin or mucosal membranes

Causes: contact with acids, alkalis and other corrosive substances

Signs and symptoms: Acids (pH < 7) causes dry necrosis, alkalis cause deep slushy necrosis

First aid: Always protect yourself. Remove all chemical (clothes, excess chemical). Irrigate wound with large volume of clean water (neutralisation is contraindicated because of heat production). In case of swallowing avoid producing vomiting. Use sterile dressing, call EMS

18.6. Frostbites

(source http://emedicine.medscape.com/article/926249-overview)

Definition: local injury of skin sometimes with subcutaneous tissues by freezing and crystalizing of fluids in the interstitial and cellular spaces as a consequence of prolonged exposure to freezing temperatures.

Causes: Mechanisms of frostbite injury include direct cold damage to cells, direct cell damage from ice crystals, indirect cell damage from intracellular dehydration caused by the presence of extracellular ice crystals, microvascular stasis, thrombus formation, ischemia and finally reperfusion inflammatory injury after rewarming.

History: Frostbite may occur when skin is exposed to a temperature lower than -10°C, resulting in vasoconstriction. The resultant decrease in blood flow does not deliver sufficient heat to the tissue to prevent the formation of ice crystals. The anatomic sites most susceptible to frostbite include hands, feet, and exposed tissues (e.g., ears, nose, and lips).

Classification: All frostbites usually look the same before rewarming and final result (extent of damage) cannot be assessed in first aid. Skin is pale, with light violet tone, insensitive, painless, cool, movement of finger may be limited. In course of hours or days after rewarming, final degree can be assessed.

- **First degree**: Superficial injury. Characterized by localized pallor with waxy texture and anaesthesia with surrounding erythema and tissue oedema.
- **Second degree**: Superficial partial-thickness injury. Characterized by clear fluid-filled blisters that form within the first 24 hours and are located at the distal aspects of the affected tissue.
- **Third degree**: Deep partial-thickness injury. Characterized by smaller, more proximal haemorrhagic vesicles.
- **Fourth degree**: Full thickness injury. Characterized by tissue injury that extends into underlying muscle, tendon, and bone. On exam, tissue is firm and non-mobile with inability to move tissue over the underlying bone. Results in tissue mummification.

REMBER: before rewarming all fresh frostbites look the same (grade 1).

Picture 73: Frostbite 1st degree (source absolventi.gymcheb.cz)

Picture 74: Frostbite 2nd degree

Picture 75: Frostbite 3rd degree

First aid: The primary defence against frostbite is to get out of the cold. Use warm bath (40 deg. C) to rewarm wounded area, avoid hot bath because o decreased sensitivity may lead to scaffolding.

- Do not rub affected areas and never rub snow on frostbitten skin as this causes further damage because of the presence of ice crystals in the skin
- Do not use dry heat to thaw frostbitten areas, moist heat is better because it allows a more complete thaw
- Do not allow the injury to thaw then refreeze, therefore hospital rewarming is favoured over field rewarming.
- Do not give alcohol
- Do not rupture blisters
- Don't walk on frostbitten feet or toes if possible

Patients should be informed that the frostbitten area may be more sensitive to cold with associated burning and tingling. Individuals who have sustained a cold-related injury are at a 2- to 4-fold greater risk of developing a subsequent cold-related injury.

Risks:

REMEMBER: never rewarm injured body part if there is a risk of new freezing. After rewarming must injured part never freeze and one cannot walk on rewarmed feet with frostbite (transport is necessary).

18.7. Electric current injury

(Source *http://emedicine.medscape.com/article/770179-clinical#b4*)

Definition: injury caused by electric current passing through body

Mechanism: Electrical injuries are typically divided into high-voltage and low-voltage injuries, using 500V or 1000V as the cut-off. High morbidity and mortality has been described in 600V direct current injury associated with railroad "third rail" contact. Current passing directly through the body will heat the tissue causing electrothermal burns, both to the surface of the skin as well as deeper tissues, depending on their resistance. There may be significant damage to underlying tissue while largely sparing the surface of the skin. It will typically cause damage at the source of contact point and the ground contact point. These burns may appear as painless, depressed areas with central necrosis and minimal bleeding. The presence of surface burns does not accurately predict the extent of possible internal injuries, as skin with high resistance will transmit energy to deeper tissues with lower resistance.

In low-voltage (household) electricity is added a risk of ventricular fibrillation. Low-voltage AC may result in significant injury if there is prolonged, tetanic muscle contraction. In high-voltage electricity, any direct contact is not necessary, electric arch (similar to lightning) can cause severe devastating burns. Ignition of clothing causes direct burns from flames.

First aid: according to type of injury:

Low-voltage (<1000V)

- Switch off the current and/or break contact of electric circuit with the victim
- Check vital functions – start resuscitation if necessary (see chapter *3 Resuscitation*)
- Treat burns (see chapter *18.4 Burns*)
- Treat other injuries
- Call EMS if necessary

High-voltage (>1000 V)

- Do not try to separate the person from current unless you are absolutely sure the victim or his surrounds is not in contact with electric current. Safe distance is 15 – 17 m.
- Call 112 – the local power company must shut the circuit off, call EMS
- When you can safely touch the person assess vital functions
- Start resuscitation if needed
- Treat burns (see chapter *18.4 Burns*)
- Treat other injuries (immobilise fractures, stop bleeding etc.), apply anti-shock measures

REMEMBER: do not approach the victim with high-voltage injury unless you are absolutely sure it is safe.

Lightning injury

(source *http://emedicine.medscape.com/article/770642-overview*)

History: look for indirect signs: lightning or thunderstorm, victims with burns under the tree etc. –

Causes: Few individuals experience the full energy of a lightning strike because only about 3-5% of injuries are from a direct strike. Most of the energy is mediated by other factors, including the ground, a tree, or other object that, once hit, transmits the energy to the person. In fact, fewer than half of affected persons have signs of burns or any other marks.

Signs and symptoms: Mild lightning injury is rarely associated with superficial burns, but persons struck often report loss of consciousness, amnesia, confusion, tingling, and numerous other nonspecific symptoms. Lightning burns are invariably superficial and have little or no deep tissue damaging effects.

Moderate lightning injury may cause seizures, respiratory arrest, or cardiac standstill, which spontaneously resolves. There is a risk of chronic problems.

Patients with severe lightning injury usually present with cardiopulmonary arrest and burns.

First aid: as in injury caused by high voltage electricity (of course no risk to touch the patient).

18.8. Drowning

Definition: Drowning is a process resulting in primary respiratory impairment from submersion/immersion in a liquid medium. The victim may live or die after this process but whatever the outcome, he or she has been involved in a drowning incident. Previously used descriptions such as near-drowning, wet and dry drowning and secondary drowning are potentially confusing and these terms are no longer recommended.

Causes:

The process of drowning begins with submersion or immersion of the airway in water, leading to breath-holding, panic, swallowing of water, aspiration and laryngospasm. Usually so-called diver reflex occurs (bradycardia, apnoe, centralization of circulation). Hypoxia and hypercapnia develop and unconsciousness ensues. Eventually the larynx relaxes and fluid is aspirated into the lungs resulting in worsening hypoxia and a mixed metabolic and respiratory acidosis. Survivors probably aspirate less than 3e4 ml/kg fluid which may be contaminated with sand, mud, vomit or other debris. It was previously thought that some victims had persistent laryngospasm resulting in 'dry drowning', but it is now considered more likely that these patients died from an alternative cause prior to submersion. The complex issues of hypothermia in drowning are discussed below.

- **Cardiovascular pathology**

  During drowning there is initially hypertension and tachycardia with activation of the sympathetic nervous system. However, worsening hypoxia, acidosis and hypothermia lead to bradycardia, pulmonary hypertension and decreased cardiac output. Atrial fibrillation and other arrhythmias may occur, ultimately progressing to cardiac arrest.

- **Respiratory pathology**

  Several mechanisms contribute to the development of alveolar oedema and acute respiratory distress syndrome (ARDS) which occurs in up to 70% of symptomatic survivors of drowning. Surfactant (substance preventing lung alveoli to collapse) washout and dysfunction results in atelectasis and the combined effect is hypoxia.

- **Neurological pathology**

  Hypoxic brain injury is the leading cause of morbidity and mortality in drowning and begins within 5 minutes of inadequate cerebral oxygenation. The clinical spectrum ranges from confusion and disorientation to cerebral oedema with coma, seizures and death.

- **Fluid and electrolytes disturbances**

  In fresh water drowning, water moves from the alveoli into capillaries, causing haemodilution, hyponatraemia and haemolysis. Conversely with drowning in seawater, water moves from plasma into the alveoli exacerbating the pulmonary oedema and causing hypernatraemia and hypovolaemia. In any way there is no reason why to waste time and try to remove water from lungs.

- **Infective complications**

  Aspirated fluid may be contaminated with a variety of microorganisms, leading to infection in up to 50% of cases.

Remark

Other causes of health disturbances during swimming are hypothermia (see chapter *18.1 Hypothermia*), reflex extreme bradycardia (so called vagal death) and head and cervical spine injury after jumping into shallow water (see chapter *11 Peripheral and central nervous system disturbances*). Further possible injury may cause rupture of the lung with resulting pneumothorax caused by overpressure after jumping into water after already having inspirated large amounts of water . Any uncommon dyspnea, cough and chest pain should be examined by a doctor (see chapter *13.1.1 Pneumothorax*). A rare condition is air embolism which occurs after similar circumstances (Amateur divers) that is caused by pushing air bubbles directly into pulmonary capillaries and being transported to the heart and brain. Symptoms are arrhythmias, confusions, drowning or even signs similar to some drugs intoxication.

History and epidemiology

Drowning victims usually do not cry or wave. They usually submerge quickly and unnoticed by others. Drowning is the third leading cause of unintentional injury deaths worldwide and in developed countries is responsible for 0.6 – 1.2 deaths per 100,000 per year. The incidence is high in children less than 5

years old, with a second peak in late adolescence and early adulthood. Males are 2 – 4 times more likely to die from drowning than females. Intoxication with alcohol or drugs contributes to at least 10 – 30% of drownings particularly in older age groups. Tourists have a higher risk of drowning than locals. Medical conditions associated with an increased risk of drowning include epilepsy, arrhythmias, cardiomyopathies, coronary artery disease, cerebrovascular disease, diabetes mellitus, and depression. Possibly 30% of unexplained drownings may be due to arrhythmias in the context of cardiac diseases.

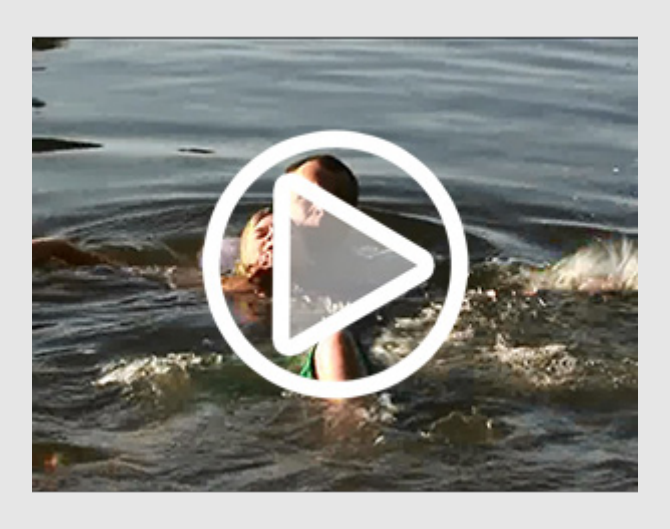
Signs and symptoms

Patient is cold, cyanotic (blueish skin color) and even in full consciousness may be confused and vomiting. In more serious cases we can see unconsciousness, loss of breathing and cardiac arrest.

Risks

Even after successful resuscitation, acute lung injury (ARDS) with dysponea, other organ disturbances and hypoxic brain injury can occur. All patients should be examined by a doctor to prevent further complications.

First aid



Video 33: Drowning

Call for help and contact EMS. The aim is to prevent hypoxia and remove the victim from water. **Safety of rescuer is a priority**. A drowning person means a risk even for trained swimmers. If possible, help from the shore by offering wood branch, paddle, oar, rope, rescue float etc. Always use floats when rescuing in deep water (see Coast Guard).

Suspect cervical spine injury in unconscious in shallow water and fix the neck as soon as possible.

Rapid rescue from the water and basic life support at the scene are essential for survival. As cardiac arrest and neurological damage in drowning are due to hypoxia, the priorities in resuscitation is to restoring oxygenation, ventilation and perfusion. Five rescue breaths are the first step in the resuscitation of drowning victims in the 2010 European Resuscitation Council Guidelines, a distinction from the resuscitation of other out-of hospital cardiac arrests. Detection of a pulse may be difficult and CPR should be performed if the patient is unresponsive and not breathing normally. However ‘compression-only CPR’ is not appropriate in drowning victims.

Patients who were submerged for less than 5 minutes, resuscitated at the scene and are conscious on arrival in the emergency department generally have a good outcome. Reported survival rates for drowning victims with cardiac arrest vary from approximately 5% to 28%, although many of these patients have neurological impairment.

Drowning is often complicated by hypothermia, which reflects the duration and severity of the incident. Uncontrolled hypothermia and the cold shock response initially cause hyperventilation, tachycardia,

shivering and activation of the sympathetic nervous system with increased oxygen consumption. Rarely uncontrolled hypothermia may be protective, observed most dramatically in case reports of children who survived prolonged submersion in near freezing water. Rapid lowering of the core temperature reduces the cerebral metabolic rate, and the 'diving reflex'; cold water stimulation of the trigeminal nerve causing apnoea, bradycardia and profound systemic vasoconstriction which may result in preferential perfusion of the heart and brain.

Further reading: Martinez FE, Hooper AJ, Drowning and immersion injury, Anaesthesia and intensive care medicine (2014), http://dx.doi.org/10.1016/j.mpaic.2014.06.006

18.9. Intoxications

Definition: injury caused by toxic substances

Causes: accidental intoxication, overdosing, suicide, crime

Classification: distinguished according to route of administration of the substance

- Oral (by indigestion, or swalowing)
- Inhalation (by inhalation)
- Contact (by staining)
- Parenteral (by injection or biting)
- Mixed

History: see causes

Signs and symptoms: depend on the type of substance, may occur after some period of time

Common rules of first aid:

- safety of rescuer
- prevention of secondary injury – (hypothermia, pressure sores, aspiration of gastric content etc.)
- prevention of further absorption of the toxic substance
- acceleration of elimination
- specific antidotes if available
- symptomatic therapy
- CPR if necessary

18.9.1. Oral intoxications

- Check and monitor the person's airway, breathing, and pulse. If necessary, begin rescue breathing and CPR.
- Try to make sure that the person has indeed been poisoned. It may be hard to tell. Some signs include chemical-smelling breath, burns around the mouth, difficulty breathing, vomiting, or unusual odors on the person.
- If possible, identify the poison.
- Induce vomiting if indicted and not contraindicated (see below). Use self stimulation done by victim with his fingers on the back of tongue or use warm water with 1 – 3 tea spoon of salt/1 l of water. Do not give more than 200 ml at once. Never use water without salt; it can accelerate absorption. Too much salt can cause gastric bleeding.
- Save the vomit. It may help experts identify what medicine can be used to help reverse the poisoning.
- Allow vomit, until the content is clear.
- Give charcoal in clear water to drink 0.5 – 1 g/1 kg b.w.
- If the person starts having convulsions, give convulsion first aid.

- Keep the person comfortable. The person should be rolled onto the left side and should stay in that position while getting or waiting for medical help.
- If the poison has spilled on the person's clothes, remove the clothing and flush the skin with water.
- **Never give milk to drink or edible oils** – it can accelerate absorption of lipophilic drugs
- **Never induce vomiting in case of**
    - disturbance of consciousness
    - convulsions
    - swallowing of corrosive substances like acids and alkalis
    - substances producing foam
    - swallowing of petrol and petrol products
    - if the interval after swallowing is longer than 1 – 2 hours

Alcohol intoxication

Signs and symptoms: disturbances of behaviour and consciousness

First aid: as in other intoxications with depressed consciousness (lethal dose in an adult is 300 – 600 g of pure ethanol)

REMEMBER: plasmatic level of alcohol can increase even after one stops drinking. Never leave a person alone in this case.

- Protect the person from injury.
- Keep the person still and comfortable.
- Stay with a drunk person who is vomiting.
- If the person is in bed, make sure the person is on his/her side—not back. Make sure the airway remain open in case of vomiting.
- Speak in a clear, firm, soothing voice. Comfort and reassure the person.
- If the person is unresponsive, get emergency medical care immediately.

Ethylene glycol intoxication

History: Ethylene glycol may be swallowed accidentally, or it may be taken deliberately in a suicide attempt or as a substitute for drinking alcohol (ethanol). Ethylene glycol is a colorless, odorless, sweet-tasting chemical found in many household products, including antifreeze, deicing products, detergents, paints, and cosmetics.

Signs and symptoms: the first symptom of ethylene glycol ingestion is similar to the feeling caused by drinking alcohol (ethanol). Within a few hours, more toxic effects become apparent. Symptoms may include nausea, vomiting, convulsions, stupor, or even coma. An overdose of ethylene glycol can damage the brain, lungs, liver, kidneys, and lungs. The disturbances may be severe enough to cause profound shock, organ failure, and death. As little as 100 milliliters of ethylene glycol may be enough to kill an average-sized man.

First aid: activate EMS, induce vomiting if the interval from ingestion is no longer than 1 hour and give activated charcoal. Give 0,05 až 0,1 l of 40 % alcoholic beverage (till signs of light drunkennes) to slow the formation of the poisonous by-products (glycolaldehyd, glyoxalic acid, formic acid and glycin) in the body to postpone renal injury before medical treatment with haemodialysis can start.

18.9.2. Inhalational intoxication

Signs and symptoms: depending on the substance they cause disturbance of consciousness (organic solvents like toluene etc.), lung injury (burning of plastics), or hypoxia (carbon monoxide).

Organic solvents (sniffers, junkies)

Signs and symptoms: disturbances of consciousness, loss of airway patency, aspiration of gastric content

First aid: fresh air, otherwise as in other causes of unconsciousness and airway problems

Carbon monoxide poisoning

History: whether the person was in an enclosed space or in a room with combustion fumes. Combustion of organic matter under conditions of restricted oxygen supply produces CO.

Cause: Carbon monoxide mainly causes adverse effects in humans by combining with hemoglobin to form carboxyhemoglobin (HbCO) in the blood. This prevents hemoglobin from carrying oxygen to the tissues, effectively reducing the oxygen-carrying capacity of the blood, leading to hypoxia.

Signs and symptoms of carbon monoxide poisoning:

- Light intoxication – headache, dizziness, weakness, nausea, vomiting,
- Medium intoxication – sleepiness, and confusion
- Heavy intoxications – unconsciousness.

The color of skin is always pink, in sever cases cherry red.

Concentration in air	Symptoms
35 ppm (0.0035%)	Headache and dizziness within six to eight hours of constant exposure
100 ppm (0.01%)	Slight headache in two to three hours
200 ppm (0.02%)	Slight headache within two to three hours; loss of judgment
400 ppm (0.04%)	Frontal headache within one to two hours
800 ppm (0.08%)	Dizziness, nausea, and convulsions within 45 min; insensible within 2 hours
1,600 ppm (0.16%)	Headache, tachycardiadizziness, and nausea within 20 min; death in less than 2 hours
3,200 ppm (0.32%)	Headache, dizziness and nausea in five to ten minutes. Death within 30 minutes.
6,400 ppm (0.64%)	Headache and dizziness in one to two minutes. Convulsions, respiratory arrest, and death in less than 20 minutes.
12,800 ppm (1.28%)	Unconsciousness after 2–3 breaths. Death in less than three minutes.

Symptoms of CO intoxication – source *https://en.wikipedia.org/wiki/Carbon_monoxide_poisoning*

First aid: expose the patient to fresh air as soon as possible (mind your safety) and activate EMS.

Intoxication by toxic fumes

History: inhalation of fumes produced by burning of plastics or other irritant gasses

Signs and symptoms: dry cough, burning on the chest dyspnea, later on edema of lungs, coughing out pink sputum

First aid:

- Activate EMS
- Expose the patient to fresh air as soon as possible (mind your safety)
- The patient should be sitting or in a orthopnoic position
- Rest – prevent any exercise and strains

ALWAYS: the health state can deteriorate from minutes to even hours after exposition, medical examination is always necessary.

18.9.3. Contact intoxications

History: working with pesticides, herbicides, mainly in agriculture or garden.

Signs and symptoms: depends on the substance but usually presents with weakness, excessive salivation, bradycardia, disturbances of circulation and CNS.

First aid: activate EMS, use protective gloves, remove the stained clothes by cutting them into pieces (never pull over head or unstained parts of the body) and leave them for further decontamination by firemen. Wash body by rinsing it with clear water.

18.9.4. Parenteral intoxication

History: usually drug abuse

Signs and symptoms: depends on the substance but general signs include breathing, CNS disturbances, acute psychic disorders

First aid: symptomatic (see chapters *11.1 Unconsciousness* and *11.6 Acute psychic disorder*)

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19. Polytrauma

Definition

- **Polytrauma** is a short verbal equivalent used for two or more severe injuries in at least two areas of the body. At least one out of two or more injuries or the sum total of all injuries endangers the life of the injured person
- **Multiple trauma** – two or more severe injuries in one body area (e.g. multiple fractures)
- **Monotrauma** injury of a single system, may be life-threatening (abdominal, or CNS injury)
- **Mixed traum**a injuries caused by at least two mechanisms, e.g. high-voltage current injury plus mechanical trauma caused by fall of electricity pylon.

Causes: serious injury

History: injury

First aid is provided by steps. See *Video 18: First aid at the site of accident. A motorcyclist*

REMEMBER: If someone needs help, before you go up to them check – is it safe?

1. **Primary survey** = recognise life-threatening problems
2. **Resuscitation** = treat life-threatening problems
3. **Secondary survey** = detailed examination
4. **Definitive treatment** = may be delayed

1. Primary Survey

(source https://en.wikipedia.org/wiki/Advanced_trauma_life_support)

Remember the acronym:

(**C**atastrophic haemorrhage control)
Airway and cervical spine control
Breathing and ventilation
Circulation and haemorrhage control
Disability (Displaced brain) or neurological status
Exposure depending on environment

Airway maintenance with cervical spine protection

The first stage of the primary survey is to assess the airway. If the patient is able to talk, the airway is likely to be clear. If the patient is unconscious, he/she may not be able to maintain his/her own airway. The airway can be opened using a chin lift or jaw thrust. Airway adjuncts may be required. If the airway is blocked (e.g., by blood or vomit), the fluid must be cleaned out of the patient's mouth by the help of suctioning instruments. In case of obstruction, pass an endotracheal tube.

Breathing and ventilation

The chest must be examined. If you see problems, try to find the cause and treat it, if possible. Subcutaneous emphysema and tracheal deviation must be identified if present. The aim is to identify and manage six life-threatening thoracic conditions such as airway obstruction, tension pneumothorax, massive haemothorax, open pneumothorax, flail chest segment with pulmonary contusion and cardiac tamponade. flail chest, tracheal deviation, penetrating injuries and bruising can be recognised by inspection. subcutaneous emphysema can be recognised by palpation. tension pneumothorax and haemothorax can be recognised by percussion and auscultation.

Circulation with hemorrhage control

Hemorrhage is the predominant cause of preventable post-injury deaths. Hypovolemic shock is caused by significant blood loss. Stop major external bleeding. This may be sometimes the first step, depending on the circumstances.

Disability/Neurologic assessment

During the primary survey a basic neurological assessment is made, known by the mnemonic AVPU (alert, verbal stimuli response, painful stimuli response, or unresponsive). A more detailed and rapid neurological evaluation is performed at the end of the primary survey. This establishes the patient's level of consciousness, pupil size, reaction, lateralizing signs, and spinal cord injury level.

The Glasgow Coma Scale is a quick method to determine the level of consciousness, and is predictive of patient outcome. If not done in the primary survey, it should be performed as part of the more detailed neurologic examination in the secondary survey. An altered level of consciousness indicates the need for immediate reevaluation of the patient's oxygenation, ventilation, and perfusion status.

Acronym AVPU is used for examination of consciousness and pupil size. You want to know, if a patient is

- Alert (conscious)
- Voice responsive (reacts to verbal command)
- Pain responsive (reacts to pain)
- Unresponsive (does not react)

Not too much can be done with disturbed neurological status during first aid, but it should be noticed for possible changes in the future.

Glasgow coma scale

Glasgow Coma Scale

Best eye response (E)	Spontaneous--open with blinking at baseline	4
	Opens to verbal command, speech, or shout	3
	Opens to pain, not applied to face	2
	None	1
Best verbal response (V)	Oriented	5
	Confused conversation, but able to answer questions	4
	Inappropriate responses, words discernible	3
	Incomprehensible speech	2
	None	1
Best motor response (M)	Obeys commands for movement	6
	Purposeful movement to painful stimulus	5
	Withdraws from pain	4
	Abnormal (spastic) flexion, decorticate posture	3
	Extensor (rigid) response, decerebrate posture	2
	None	1

Call EMS after primary survey and resuscitation treatment is done (if alone, otherwise somebody else can do it during survey)

Exposure and environmental control

The patient should be completely undressed, usually by cutting off the garments. It is imperative to cover the patient with warm blankets to prevent hypothermia. Patient privacy should be maintained

2. Resuscitation

Resuscitation is performed simultaneously with primary survey

Life-threatening problems should be recognised but also immediately treated. After finishing the primary survey, you can continue to secondary survey.

3. Secondary Survey

When the primary survey is completed, resuscitation efforts are well established, and the vital signs are normalizing, the secondary survey can begin. The secondary survey is a head-to-toe evaluation of the trauma patient, including a complete history, physical examination and including the reassessment of all vital signs. Each region of the body must be fully examined.

4. Definitive Care

Definitive care is rarely performed by first aid providers. But it is good to remember, that if primary care and first aid is not performed correctly, final care can be done by funeral services.

CONCLUSIONS

Always keep in mind

- Is airway open?
- Is breathing all right?
- Is there still any major bleeding present that can be stopped?

20. Mass casualty, disaster

Definition: any incident in which emergency medical services resources, such as personnel and equipment, are overwhelmed by the number and severity of casualties. If number of victims exceeds national resources it is called a disaster. A formal declaration is done by an appropriate EMS authority or integrated rescue system authority

Causes: traffic accidents, fires, intoxications, wars, natural disasters, industrial disasters

Activities: first activate integrated rescue system (IRS) (tel. 112), similar to activation of EMS (See chapter *2 Action at the Site of a Medical Emergency*).

Next step is triage.

(source *http://www.medicinenet.com/script/main/art.asp?articlekey=79529*)

Triage refers to the evaluation and categorization of the sick or wounded when there are insufficient resources for medical care of everyone at once. Historically, triage is believed to have arisen from systems developed for categorization and transport of wounded soldiers on the battlefield. Triage is used in a number of situations in modern medicine, including:

In mass casualty situations, triage is used to decide who is most urgently in need of transportation to a hospital for care (generally, those who have a chance of survival but who would die without immediate treatment) and whose injuries are less severe and must wait for medical care.

Triage is also commonly used in crowded emergency rooms and walk-in clinics to determine which patients should be seen and treated immediately.

Triage may be used to prioritize the use of space or equipment, such as operating rooms, in a crowded medical facility.

In a disaster or mass casualty situation, system that is known as START (Simple Triage and Rapid Treatment) has been developed. One. In START, victims are grouped into four categories, depending on the urgency of their need for evacuation. If necessary, START can be implemented by persons without a high level of training. The categories in START are:

- the deceased, who are beyond help
- the injured who could be helped by immediate transportation
- the injured with less severe injuries whose transport can be delayed
- those with minor injuries not requiring urgent care.

Another system that has been used in mass casualty situations is an example of advanced triage implemented by nurses or other skilled personnel. This advanced triage system involves a color-coding scheme using red, yellow, green, white, and black tags:

- **Red tags** – (immediate) are used to label those who cannot survive without immediate treatment but who have a chance of survival. Example: major haemorrhage, states after successful resuscitation, breathing disturbances, all types of pneumothorax, intracranial injury)
- **Yellow tags** – (observation) for those who require observation (and possible later re-triage). Their condition is stable for the moment and, they are not in immediate danger of death. These victims will still need hospital care and would be treated immediately under normal

circumstances. Example: abdominal injury, open and closed fractures and dislocations, amputations, extensive soft tissue injury, face and eye injury

- **Green tags** – (wait) are reserved for the "walking wounded" who will need medical care at some point, after more critical injuries have been treated.
- **White tags** – (dismiss) are given to those with minor injuries for whom a doctor's care is not required.
- **Black tags** – (expectant) are used for the deceased and for those whose injuries are so extensive that they will not be able to survive given the care that is available. Relieve of pain and suffering is provided.

Practical approach

(source *http://www.cert-la.com/triage/start.htm*)

By using a casualty sorting system, you are focusing your activities in the middle of a chaotic and confusing environment. You must identify and separate patients rapidly, according to the severity of their injuries and their need for treatment.

En route

Even while you are responding to the scene of an incident, you should be preparing yourself mentally for what you may find. Perhaps you've been to the same location. Where will help come from? How long will it take to arrive?

Initial Assessment – Stay Calm

The first thing you should do upon arriving at the scene of an incident is to try to stay calm, look around, and get an overview of the scene. These visual surveys give you an initial impression of the overall situation, including the potential number of patients involved, and possibly even the severity of their injuries. The visual survey should enable you to estimate initially the amount and type of help needed to handle the situation.

Your Initial Report – Creating a Verbal Image

The initial report is often the most important message of a disaster because it sets the emotional and operational stage for everything that follows. As you prepare to give the first vital report, use clear language (no signals or radio jargon), be concise, be calm, and do not shout. You are trying to give the communications centre a concise verbal picture of the scene.

The key points to communicate are:

- Location of the incident
- Type of incident
- Any hazards
- Approximate number of victims
- Type of assistance required

Note: Be as specific with your requests as possible. Field experience has shown that a good rule of thumb initially, in multiple- or mass-casualty situations, is to request one ambulance for every five patients. For example, for 35 patients, request seven ambulances; for 23 patients request five ambulances, and so forth.

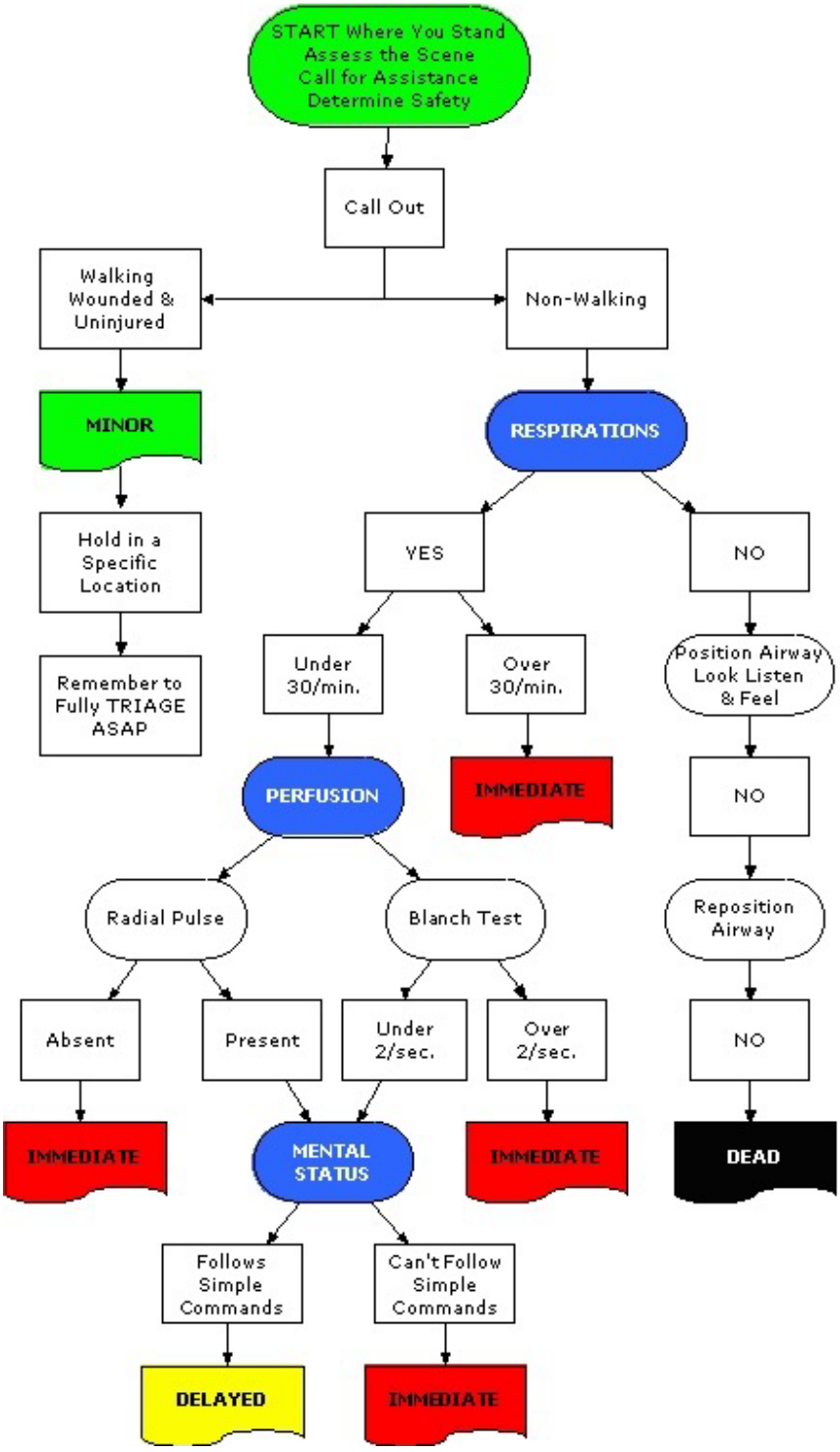
Before starting, take several deep breaths to give your mind time to catch up with your eyes and to try to calm your voice. You might give the following report: "This is a major accident involving a truck and a commercial bus on Highway 305, about 2 miles east of Route 610. There are approximately 35 victims. There are people trapped. Repeat: This is a major accident. I am requesting the fire department, rescue squad, and seven ambulances at this time. Dispatch additional police units to assist."

Sorting the Patients

It is important not to become involved with the treatment of the first or second patient with whom you come in contact. Remember that your job is to get to each patient as quickly as possible, conduct a rapid assessment, and assign patients to broad categories based on their need for treatment.

You cannot stop during this survey, except to correct airway and severe bleeding problems quickly. Your job is to sort (triage) the patients. Other rescuers will provide follow-up treatment.

The **START** System: It really works!



Picture 76: Simple Triage And Rapid Treatment

The **S**imple **T**riage **A**nd **R**apid **T**reatment (**START**) system was developed to allow first responders to triage multiple victims in 30 seconds or less, based on three primary observations: **R**espiration, **P**erfusion, and **M**ental Status (**RPM**).

The **START** system is designed to assist rescuers to find the most seriously injured patients. As more rescue personnel arrive on the scene, the patients will be re-triaged for further evaluation, treatment, stabilization, and transportation. This system allows first responders to open blocked airways and stop severe bleeding quickly.

Triage Tagging: To Tell Others What You've Found

Patients are tagged for easy recognition by other rescuers arriving on the scene. Tagging is done using a variety of methods determined by your local Emergency Services System. Colored surveyors' tape or colored paper tags may be used.

Minor	delayed care / can delay up to three hours
Delayed	urgent care / can delay up to one hour
Immediate	immediate care / life-threatening
Dead	victim is dead / no care required

The First Step in START: Get up and Walk!

The first step in **START** is to tell all the people who can get up and walk to move to a specific area. If patients can get up and walk, they are probably not at risk of immediate death. In order to make the situation more manageable, those victims who can walk are asked to move away from the immediate rescue scene to a specific designated safe area. These patients are now designated as Minor. If a patient complains of pain on attempting to walk or move, do not force him or her to move. The patients who are left in place are the ones on whom you must now concentrate.

The Second Step in START: Begin Where You Stand

Begin the second step of START by moving from where you stand. Move in an orderly and systematic manner through the remaining victims, stopping at each person for a quick assessment and tagging. The stop at each patient should never take more than one minute.

REMEMBER: Your job is to find and tag the Immediate patients – those who require immediate attention. Examine each patient, correct life-threatening airways and breathing problems, tag the patient with a red tag and MOVE ON!

How To Evaluate Patients Using RPM

The START system is based on three observations: RPM – Respiration, Perfusion and Mental Status. Each patient must be evaluated quickly, in a systematic manner, starting with Respiration (breathing).

Respiration or Breathing: It all **STARTS** Here.

If the patient is breathing, you then need to determine the breathing rate. Patients with breathing rates **greater than 30 per minute** are tagged Immediate. These patients are showing one of the primary signs of shock and need immediate care.

If the patient is breathing and the breathing rate is less than 30 per minute, move on to the circulation and mental status observations in order to complete your 30-second survey.

If the patient is not breathing, quickly clear the mouth of foreign matter. Use a head-tilt maneuver to open the airway. In this type of multiple- or mass-casualty situation, you may have to ignore the usual cervical spine guidelines when you are opening airways during the triage process.

SPECIAL NOTE: The treatment of cervical spine injuries in multiple or mass casualty situations is different from anything that you've been taught before. This is the only time in emergency care when there may not be time to properly stabilize every injured patient's spine.

Open the airway, position the patient to maintain the airway and – if the patient breathes – tag the patient Immediate. Patients who need help maintaining an open airway are Immediate.

If you are in doubt as to the patient's ability to breathe, tag the patient as Immediate. If the patient is not breathing and does not start to breathe with simple airway **manoeuvres**, the patient should be tagged Dead.

Perfusion or Circulation: Is Oxygen Getting Around?

The second step of the RPM series of triage tests is circulation of the patient. The best field method for checking circulation (to see if the heart is able to circulate blood adequately) is to check the radial pulse.

It is not large and may not be easily felt in the wrist. The radial pulse is located on the palm side of the wrist, between the midline and the radius bone (forearm bone on the thumb side). To check the radial pulse, place your index and middle fingers on the bump in the wrist at the base of the thumb. Then slide it into the notch on the palm side of the wrist. You must keep your fingers there for five to ten seconds, to check for a pulse. If the radial pulse is absent or irregular the patient is tagged Immediate.

If the radial pulse is present, move to the final observation of the RPM series: Mental status.

Mental Status: Open Your Eyes

The last part of the RPM series of triage tests is the mental status of the patient. This observation is done on patients who have adequate breathing and adequate circulation.

Test the patient's mental status by having the patient follow a simple command:

- "Open your eyes."
- "Close your eyes."
- "Squeeze my hand."

Patients who can follow these simple commands and have adequate breathing and adequate circulation are tagged Delayed. A patient who is unresponsive or cannot follow this type of simple command is tagged Immediate. (These patients are "unresponsive" to verbal stimuli.)

START is Used to Find Immediate **Patients**

This system is designed to assist rescuers to find the most seriously injured patients. As more rescue personnel arrive on the scene, the patients will be re-triaged for further evaluation, treatment, stabilization, and transportation. A patient may be re-triaged as many times and as often as time allows.

Remember that injured patients do not stay in the same condition. The process of shock may continue and some conditions will become more serious as time goes by. As time and resources permit, go back and recheck the condition of all patients to catch changes in condition that may require upgrading to Immediate attention.

Working at a Multiple- or Mass-Casualty Incident

You may or may not be the first person to arrive on the scene of a multiple- or mass-casualty incident. If other rescuers are already at the scene when you arrive, be sure to report to the incident commander before going to work. Many events are happening at the same time and the incident commander will

know where your help and skills can best be used. By virtue of training and local protocols, the incident commander is that person who is in charge of the rescue operation.

In addition to initially sizing up an incident, clearly and accurately reporting the situation, and conducting the initial **START** triage, the first responder will probably also be called on to participate in many other ways during multiple- and mass-casualty incidents.

As more highly trained rescue and emergency personnel arrive on the scene, accurately report your findings to the person in charge by using a format similar to that used in the initial arrival report. Note the following:

- Approximate number of patients.
- Numbers that you've triaged into the four levels.
- Additional assistance required.
- Other important information.

After you have reported this information, you may be assigned to use your skills and knowledge to provide patient care, traffic control, fire protection, or patient movement. You may also be assigned to provide emergency care to patients, to help move patients, or to assist with ambulance or helicopter transportation. In every situation involving casualty sorting, the goal is to find, stabilize and move Priority One patients first.

Triage in Hazardous Materials Incidents

Hazardous materials (Hazmat) incidents involving chemicals occur every day, exposing many people to injury or contamination. During a hazardous materials incident, responders must protect themselves from injury and contamination.

REMEMBER: A hazardous materials placard indicates a potential problem. But not all hazardous materials problems will be placarded. Be sure to find the proper response to the problem before beginning patient treatment.

The single most important step when handling any hazardous materials incident is to identify the substance(s) involved. Federal law requires that hazardous materials placards be displayed on all vehicles that contain large quantities of hazardous materials. Manufacturers and transporters should display the appropriate placard, along with a four-digit identification number, for better identification of the hazardous substance. These numbers are used by professional agencies to identify the substance and to obtain emergency information.

IF THERE IS ANY SUSPICION OF A HAZARDOUS MATERIALS SPILL -STAY AWAY!

The U.S. Department of Transportation published the Emergency RespVonse Guidebook, which lists the most common hazardous materials, their four-digit identification numbers, and proper emergency actions to control the scene. It also describes the emergency care of ill or injured patients.

Unless you have received training in handling hazardous materials and can take the necessary precautions to protect yourself, you should keep far away from the contaminated area or "hot zone."

Once the appropriate protection of the rescuers has been accomplished, triage in hazardous materials incidents has one major function–to identify victims who have sustained an acute injury as a result of exposure to hazardous materials. These patients should be removed from the contaminated area, decontaminated by trained personnel, given any necessary emergency care, and transported to a hospital.

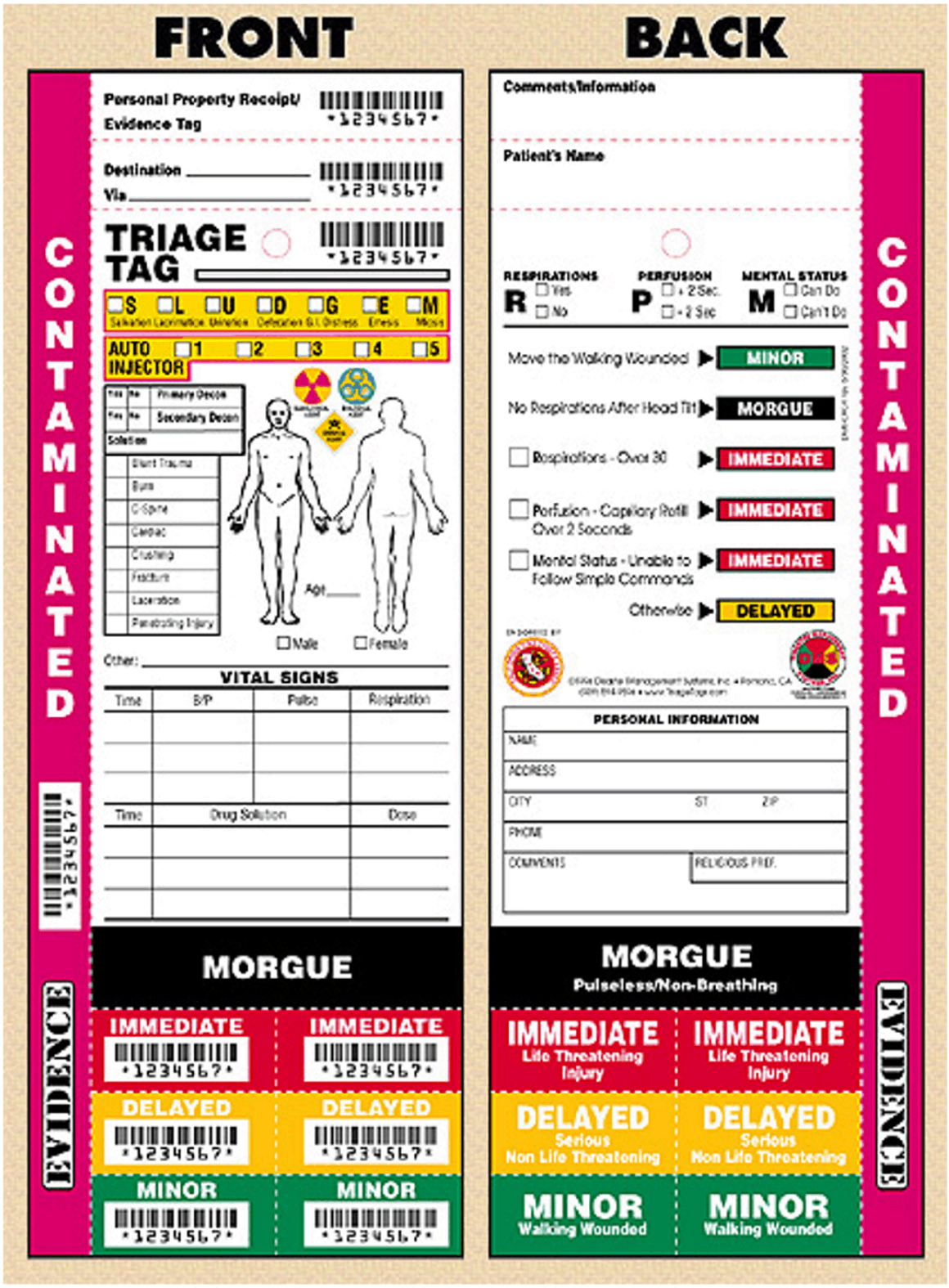
REMEMBER: Contaminated patients will contaminate unprotected rescuers!

Emergency treatment of patients who have been exposed to hazardous materials is usually aimed at supportive care, since there are very few specific antidotes or treatments for most hazardous materials injuries. Because most fatalities and serious injuries sustained in hazardous materials incidents result from breathing problems, constant reevaluation of the patients in Priorities Two and Three is necessary so that a patient whose condition worsens can be moved to a higher triage level.

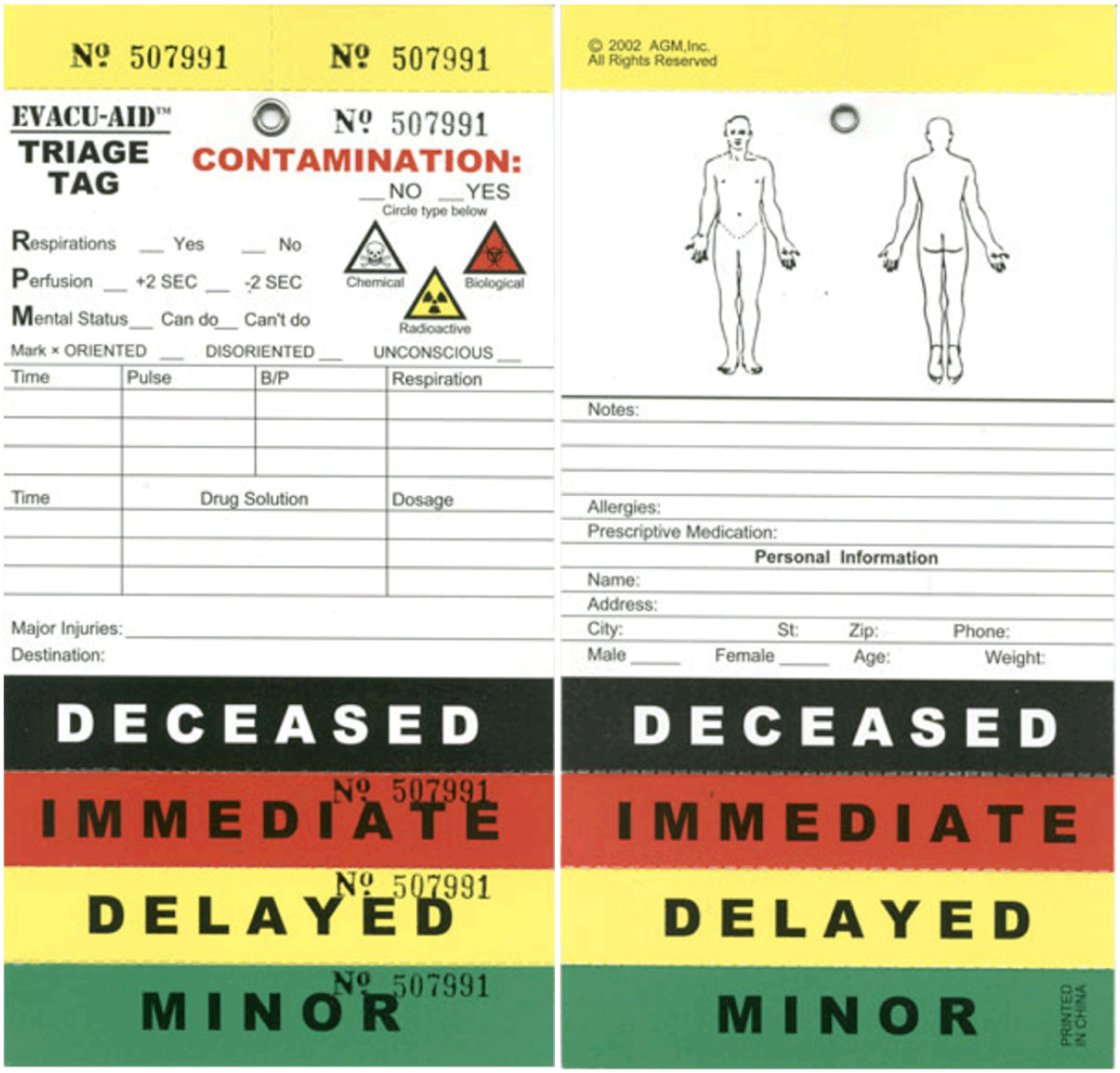
Summary

Every responder must understand the principles and operations behind your casualty sorting system. The **START** system is an excellent and easily understood triage or casualty sorting method.

Various charts are used for triage.



Picture 77: Triage charts (source blairhills.org)



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