

Injuries caused by heat and cold,
electric current, chemical agents,
drowning

Injuries caused by heat

Most often are afflicted age groups 18-30 years and small children 1-3 years old. Most of time it is injury at home, automotive or industry accidents

- Overheating of the organism
- Burns – most often is injured the skin
 - temperature above 45 degrees is able to burn in relation to the contact and time

Dry burns: burns caused by flame, radiation, direct contact with a hot object, friction

Wet burns: burns caused by hot, boiling liquid, or steam

Overheating = hyperthermia

- State of organism with body temperature raised above 39 °C
 - Causes: excessive thermal generation, excessive surrounding temperature and humidity

The organism is cooling down by these mechanisms – radiation, conduction, convection

Overheating

Physiologic reaction of the body to the overheating is vasodilatation.

Greater loss of heat through excessively perfused skin and sweating – loss of water and salts can cause decrease of intravascular volume (even hypovolemic shock).

Overheating

- Heatstroke (hyperthermia, siriasis) – headache, vomiting, thirst, tachycardia and hypotension
- Sunstroke (insolation, heliosis) – overheating of the head and neck made by direct sun heat radioation
 - headache, hyperreflexia, spasms of the neck, hypotension

Overheating

- transfer the patient to a cool shaded and well ventilated area and check basic vital functions
- recovery position in case of unconsciousness
- release tight fitting clothing and actively cool (ice pack, ventilator)
- liquids per o. – if not unconscious - mineral water, sweetened tea

Burns

- Damage to the organism is made by direct impact to the cells (necrosis) or indirect damage by oedema, ischemia
 - damage to capillaries increases their permeability, what leads to leakage of proteins and liquids into interstitial space (sign as eodema) – formation is maximized within 12 hours
 - Large area burn can cause generalized eodema and hypovolemic shock

Severity of burn

- Severity of the burn can be recognized by localization and extensity of the burned area, depth of the burn

Major (severe) burns are primarily transported to the trauma center, not to the nearest hospital.

- Depth = degree:
 - 1st degree - red, sensitive – painful, non-blistered skin
 - damage to the dermis
 - 2nd degree (partial thickness burns)
 - blisters, sensitive – painful skin
 - damage to the dermis
 - 3rd degree (full thickness burn)
 - either white leathery appearing skin (coagulation necrosis) or blackened skin (carbonification)
 - damage deeper than dermis

Burned area

- rule of 9
- palm with the fingers accounts for around 1% of the body surface
- 30% of skin surface in adults and 5% in children up to 3 years is considered as severe burn. No matter of the surface it is considered to be severe when these localizations are afflicted: face, neck, hands, genitals, sole of foot

Burn

- Minor burn
 - 1.degree burns anywhere in the body
 - 2. degree burns less than 2-3 inches (5-9cm) wide
- Major burn
 - 2. degree burns less more 2-3 inches (5-9cm) wide
 - 2. degree burns on the hands, feet, face, neck, groin, buttocks, major joints
 - 3. degree burns

Complications of the burn

- oedema at the localization or generalized
- hypovolemic shock
- cardiogenic shock due to factors released from burned area
- infections
- loss of warmth

(Inhalation trauma)

Heat Burn – First Aid

- prevent further trauma
- if the burn is a small one we may cold it under running water as long as it brings a relief to the victim, never use a desinfection, do not puncture the blisters
(1st and 2nd degree burns with up to 7cm of diameter)
- loosen everything which can eventually strangulate a given body part
- cover the burn with sterile gauze and free hydrophilic bandage

Cold injuries

- hypothermia of the organism
- frostbite (congelationes) – as in heat burns severity of the frostbite is recognized by location, area and depth of afflicted tissue
 - highest threat has peripheral locations of the body (fingers, toes, nose, chin, ears)

Frostbite

The formation of ice crystals interstitially and intracellularly make a damage to the structure and function of cell membranes.

Vasoconstriction due to hypothermia decreases a perfusion of peripheral tissues.

Damage to the endothelium of arteries – aggregation of platelets – formation of thrombus

Symptoms: pale and cool insensitive skin

Frostbite – First Aid

- earlier frostbite is treated, better the final result.
- until transport the victim to a safe area do not remove even wet pieces of clothing
- warm the afflicted areas by body warmth (armpits, hands, groin area) – frostbitten area should not be massaged; if a return of sensation is not returned within 10min, immediately arrange transport of victim
- at the end dry the frostbitten area, cover with sterile covers and bind loosely
- elevate the limb above the level of the heart
- do not puncture blisters

Frostbite – definitive treatment

- water bath 40°C also with addition of disinfection, sufficient amount of warm sweetened liquids

Hypothermia

A state in which the temperature of the body core falls under 35°C.

Under 34°C function of coagulation factors is disrupted

Under 28°C endanger of ventricular fibrillation which is most common cause of death of hypothermia

- primarily it is caused by long action of severe frost
- secondarily is seen a restricted ability of the organism to produce warmth (unconsciousness, injury, exhaustion – impossible to actively move)

Hypothermia – signs and symptoms

- cool, dry and pale skin – peripheral cyanosis
- decrease of respiratory rate and increase heart rate
- derangement of consciousness (quantitative and qualitative)
- **First Aid:** transport victim to safe and warm place, prevent further loss of warmth, warm liquids to consciousness victim

Injuries caused by electric current

- most commonly are injuries caused by low voltage current
- electric current passes through the body by the path of least resistance and causes thermal necrosis along this path (veins, nerve bundles, muscle tissue). Most of the electric resistance are centered around the properties of the skin (skin burns at the area of electrical contact)

Mechanism

- thermal damage
- derangement of normal electric potentials of the organism
- **Low voltage** causes more electrical damage
 - Heart arrhythmias, tetanic spasm of skeletal muscles
- **High voltage** causes more thermal damage (burns)

Lightning strike

- Lightning – a discharge of cumulated electrical energy of very high voltage (up to 1 million kilovolts), which takes place between clouds or between a cloud and earth

The duration of this discharge is short (about 0,001 s), which is why the energy transferred to the body is small

Thanks to the high resistance of skin and the short duration, lightning strikes tend to pass along the surface of the body (Lichtenberg figures - sometimes called lightning trees)

- tossed up to several meters (associated wounds), surface burns, unconsciousness, arrhythmias

- **First Aid:** safe area, vital functions, call for help, take care of burns

Low voltage - symptoms

- red, swollen, burned or charred skin at the point of entry and egress of electric current
- possible signs of shock, failure of vital functions (derangements of consciousness)
- arrhythmias - fibrillation of ventricles, asystole

Low voltage - First Aid

Current with a high voltage – the rescuer should not attempt approach to the victim (electrical arc can jump a distance of up to 20 meters)

- prevent further damage (turn off or short circuit, move the afflicted from the area of the source)
- check vital functions
- treatment of burned areas
- call for help

Drowning

Drowning – is a direct cause of death, near drowning precedes it

A result of submerging a person in water or another liquid is strangulation.

- wet drowning – water enters the lungs
- dry drowning – reflex causes laryngospasm – water does not enter distally into the lungs (30%)

- **Fresh water (hypoosmolar)** – osmotic haemolysis after absorption from the alveoli
- **Salt water (hyperosmolar)** – lung oedema (pulls water from body into the alveoli)

Near Drowning - symptoms

- panicked fear
- labored sporadic breathing
- hypothermia
- spasms
- lung edema (coughing up of pink froth), cyanosis
- impaired consciousness to unconsciousness
- breathing and circulatory arrest

Near Drowning – First Aid

- save the drowning individual (keep in mind your own safety), is previous injury to the head and spinal column possible
- check for vital signs, start CPR - in case of sudden circulatory arrest caused by drowning begin CPR by 2 – 5 breaths, notwithstanding the age of the afflicted.

Alone rescuer calls ES after about one minute of providing CPR. In case of several rescuers call ES and begin CPR simultaneously.

- recovery position, first aid, prevent thermal loss

Chemical Injuries

- Are causing corrosion
- severity of the burn depends on quality and quantity of the chemical, affected area
= destruction of skin/ mucous layer; it is considered to be type of burn

Signs of chemical burns

- **Skin irritation** – look similar to burns
- **Mucous layer irritation** (ingestion, inhalation)
- burning pain at the location
- swallowing and breathing difficulties

Acids make dry necrosis, coagulation of the skin proteins – boiled meat look, edges of the burn are sharp

Lye (alkali) make liquefactive necrosis (colliquative necrosis) – brown-yellow look, tend to spread wide and deep, edges are blurred

First Aid: have in mind your own safety, vital functions, prevent further damage, irrigate with running water, remove contaminated clothes, no vomiting, medical help

Poisoning

Poison is a substance which is able to cause damage to organism

– It can be any substance depending on dose and way of administration (even water)

- **Types**: accidental – children (medications, fluids)
adults (industry, fertilizers, gases)
intentional – suicidal attempts
(medications)
- **Routes of intake**: ingestion, inhalation, injection, absorption,
iatrogenic poisoning
- Most common types of poisoning: Children - various chemicals, domestic cleaners,
acids, alkali
Adults – medicines – antidepressants, paracetamol,
organophosphates, CO, (2012/13 - methanol)

Ingested poisons

- Signs:
 - vomiting, diarrhoea, abdominal pain, cramps
 - empty drug flasks/containers
 - decreased consciousness
 - seizures

First Aid: get samples of vomit/drugs/food (100 ml)
activated charcoal

Activated charcoal

- impure form of a coal, contains ash obtained by burning of animal or vegetable substances
- 1g has surface of 500 m²
- adsorption of larger molecules
- 50 – 100 g dissolved in small amount of water

Inhaled poisons

- Signs:
 - cough, wheezing, pulmonary oedema
 - risk of fast systemic absorption
 - risk of airway narrowing
- First aid: get victim out of polluted environment, mind your own safety

Poisoning

Acute p.: manifests during a short period, symptoms develop in close relation to exposure

Chronic p.: is long-term repeated or continuous exposure to a poison, symptoms do not occur immediately or after each exposure.

- poisons that bioaccumulate, or are biomagnified, such as mercury and lead

What to do?

1. examine consciousness, breathing
 2. identify the poison, amount used, approximal time of poisoning, prevent more poison to be absorbed
 3. get poison sample
 4. gather personal data (psychiatric illness, drug abuse etc.)
- at the hospital: 5) use of specific or non-specific antidotes
- nonspecific is charcoal
 - Specific is for example ethanol for methanol/ethylen glycol
- 6) fast elimination of the absorbed chemical
 - 7) supportive therapy

References

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