Environmental Emergencies

EMS Continuing Education
Technician through Technician-Advanced Paramedic

Consistent with the
National Occupational Competency Profiles
as developed by
Paramedic Association of Canada
and
"An Alternate Route to Maintenance of Licensure"
as developed by Manitoba Health

Evaluated for content by:
Pending

Developed by:
Educational Subcommittee – Paramedic Association of Manitoba

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Disclaimer

These documents were developed for improved accessibility to standardized continuing education for all paramedics in Manitoba.

This training package is consistent with the National Occupational Competency Profiles and the core competency requirements (both mandatory and optional) as identified in "An Alternative Route to Maintenance of Licensure" (ARML). It is not the intent that this package be used as a stand-alone teaching tool. It is understood that the user has prior learning in this subject area, and that this document is strictly for supplemental continuing medical education. To this end, the Paramedic Association of Manitoba assumes no responsibility for the completeness of information contained within this package.

It is neither the intent of this package to supersede local or provincial protocols, nor to assume responsibility for patient care issues pertaining to the information found herein. Always follow local or provincial guidelines in the care and treatment of any patient.

This package can be used in conjunction with accepted models for education delivery and assessment as outlined in "An Alternative Route to Maintenance of Licensure". Any individual paramedics wishing to use these continuing education packages to augment their ARML program should contact their local EMS Director.

This document was designed to encompass all licensed training levels in the province (Technician, Technician – Paramedic, Technician – Advanced Paramedic.). Paramedics are encouraged to read beyond their training levels. However, it is suggested that the accompanying written test only be administered at the paramedic's current level of practice.

This package has been reviewed by the Paramedic Association of Manitoba's Educational Subcommittee and is subject to review by physician(s) or expert(s) in the field for content.

As the industry of EMS is as dynamic as individual patient care, the profession is constantly evolving to deliver enhanced patient care through education and standards. The Paramedic Association of Manitoba would like to thank those practitioners instrumental in the creation, distribution, and maintenance of these packages. Through your efforts, our patient care improves.

This document will be amended in as timely a manner as possible to reflect changes to the National Occupational Competency Profiles, provincial protocols/Emergency Treatment Guidelines, or the Cognitive Elements outlined in the Alternate Route document.

Any comments, suggestions, errors, omissions, or questions regarding this document may be referred to info@paramedicsofmanitoba.ca , attention Director of Education and Standards.

Conventions Used in this Manual

Black lettering without a border is used to denote information appropriate to the Technician Level and above.

Text with the single striped border on the left is information appropriate to Technician - Paramedic and above.

Text with the double striped border on the left is information appropriate to Technician - (Advanced Paramedic and above.

Table of Contents

Introduction

The environment can be defined as all of the surrounding external factors that affect the development and functioning of a living organism. Human beings obviously require the environment for life. But they also must be protected from its extremes.
As a paramedic, you will frequently be called upon to treat medical emergencies related to environmental conditions. Most of these emergencies occur during the summer or winter. Understanding their causes and underlying pathophysiology can help you recognize these emergencies promptly and manage them effectively. Although many environmental factors can result in medical emergencies, this section will focus primarily on problems related to drowning or near drowning, electrical or lightning injuries, radiation burns, hot and cold emergencies, bites and stings.

Water Related Emergencies

Drowning: Death from suffocation due to submersion.

Near Drowning: Survival, at least temporary, from near suffocation due to submersion.

Wet drowning: occurs when fluid is aspirated, or allowed to enter the passage of the upper/lower airway to the lungs.

Dry drowning: occurs with laryngospasm cutting off the ability to provide respirations and not allowing a significant amount of fluid to enter the lungs.

Fresh water vs. Salt water

Fresh water: Less salt in the water than the body fluids, so water leaves the lungs and enters the blood.

Salt water: More salt in the water than in the body fluid so water leaves the blood and enters the lungs.
*Remember water follows salt!

Causes

- Exhaustion
- Losing control, rip-tide (getting caught or swept into deeper water)
- Losing a support
- Entanglement or entrapment in water (reeds, debris, car crashes)
- Drug and or alcohol ingestion
- Poor judgement
- Hypothermia
- Trauma
- Diving accident

General Management of drowning or near-drowning

- Scene assessment for mechanism of injury
- Utilization of Routine Practices and equipment as appropriate
- Ensure personal safety and safety of bystanders
- Attempt to obtain a history of the event including the length of time the patient may have been submerged
- Note the environmental conditions and the approximate temperature of the water
- Primary survey (initial assessment)
  - Can be performed prior to removing the patient from the water
  - Assess and manage ABCs
    - Initiate ventilations if required
  - Consider cervical spine protection
  - Maintenance of an open airway and ensuring adequate respirations has priority over all other treatments, including control of the cervical spine
  - Assess and manage gross bleeding
- Once the patient has been removed from the water, initiate CPR if required **(prolonged assessment of pulse and respirations may be required due to hypothermia)**
  - Airway may require extensive and ongoing clearing
  - Administer 100% oxygen using suitable delivery device
- Place patient in recovery position, if appropriate
- Consider load and go criteria
- Assess the patient for cardiac arrest and manage as indicated
  - Ensure the patient is dried off prior to defibrillation
  - Extreme care must be taken to avoid an electrical injury during defibrillation
  - Hypothermia must be considered – see section on hypothermia defibrillation procedures.
- Initiate transport
  - On scene times should be kept to a minimum
  - Treat other life-threatening conditions en route
- Transport the patient to the nearest appropriate health care facility
  - Notify the receiving health care facility of the patient's status as soon as possible
  - Transport patient in a recovery position, injuries permitting
  - Monitor and treat the patient en route
  - Additional surveys and treatments should be conducted en route
- Report all findings to the receiving facility staff, and document on the patient care report

Note

- Scene safety and possible bystander control must be continuously reassessed
- Bronchospasm may make it difficult to ventilate
  - Repositioning and bag-valve-mask ventilation may make ventilation possible
  - If the airway remains obstructed
    - Initiate immediate load and go

- Continue to attempt to ventilate en route

- ❖ Assume a cervical spine injury may be present and modify patient positioning and airway maeuvers appropriately
- ❖ Treat all drowning and near drowning patients as possible hypothermia patients
- ❖ Assess the patient for other injuries and treat if EMS staff availability, time and the patient's condition permit

Factors that affect Survival

- ❖ Cleanliness of water
- ❖ Length of time submerged
- ❖ Age and general health of patient
- ❖ Water temperature

Do not enter a water rescue unless you are a qualified water rescue technician, lifeguard or wearing a life jacket or PFD. Know your own limits.

Barotrauma Emergencies

Barotrauma is physical damage to the body tissues caused by a difference in pressure between air space inside the body and the surrounding liquid or gas pressures. Barotrauma typically occurs to air spaces within a body when that body moves to or from a higher pressure environment, such as when SCUBA diving, free-diving, airplane ascent/decent, and uncontrolled decompression of a pressure vessel (plane, submarine).

Damage occurs in the tissues around the body's air spaces because gases are compressible and the tissues are not. Barotrauma can be divided into two classifications:

Barotrauma of Ascent:

During ascent, the physics of gas in air-containing organs is opposite that of descent, and the air will expand as the pressure decreases
Middle Ear/Sinus Effects
Air will flow through the ostia of the sinuses, and expand in the middle ear causing the Eustachian tube to open.
Should the air be trapped temporarily in the middle ear, it will expand causing unequal vestibular impulses to the brain, resulting in vertigo. This is usually transient and requires no specific treatment.
Pulmonary Effects
If a diver ascends breathing compressed air with a closed glottis (holds breath, coughs, vomits) most seen in rapid, panicked out-of-air ascent, the expanding lung may rupture.
Serious cases of this may require needle decompression for tension Pneumothorax, but most commonly is treated with oxygen.
Pulmonary barotrauma may also occur due to non-ascending related etiologies:
COPD or other air trapping illnesses

Blast induced barotraumas (explosions)
Ventilator induced barotraumas (absolute pressures used in order to ventilate non-compliant lungs)

Barotrauma of Descent:

During descent the volume of gas in all air-containing body cavities decreases. The air space of the middle ear makes the tympanic membrane the tissue most commonly affected by this phenomenon, if active measures such as "popping the ears" using valsalva or other techniques is not successful. As the volume of gas decreases, the tympanic membrane is bent inward causing a feeling of fullness or pain. Popping of the ears, allowing the air through the Eustachian tube, relieving the pressure.
Barotitis can range from symptoms of pain or fullness without otoscopic changes, to hemorrhage within the tympanic membrane or hemorrhage in the middle ear.

Treatment of Barotrauma:

The treatment of barotrauma in the EMS field is limited. Supportive oxygen and ventilation may be appropriate. Use of needle decompression (although uncommon) may be indicated for relief of a life-threatening tension Pneumothorax. In severe cases, the patient may be transferred to a facility capable of a recompression chamber.

Electrical or Lightning Injuries

Four key functions of the skin

- Protect the body from outside environment or pathogens
- An organ of sensation, perceives temperature, pressure and pain
- Regulates temperature through sweat and shunting of blood.
- Provides a barrier against infection as well as insulates against trauma

Burn Categories

Thermal - the most common type. Dry heat, wet heat, radiation, friction, hot objects, or chemicals can cause these types of burns. Airway burns can be caused by inhalation. Improper handling of items is also a cause of thermal burns.

Electrical - the human body is a good conductor of electricity. Some electrical burns may look minor, but could be fatal. Damage to the internal organs may be severe, especially to the musculoskeletal, nervous and cardiovascular system. The following variables affect patient survival: site and extent of damage, state of health prior to incident and the speed and adequacy of treatment. Three ways that electrical current cause injuries are cardiac arrest, muscle destruction resulting from the passing of current through the body and thermal burns due to contact with an electrical source.

Chemical - these burns occur due to the skin's contact with a caustic agent. These reactions can be local (the immediate area) or systemic (whole body). Chemical exposure is not always obvious. Keep a high index of suspicion.

Burn Classifications

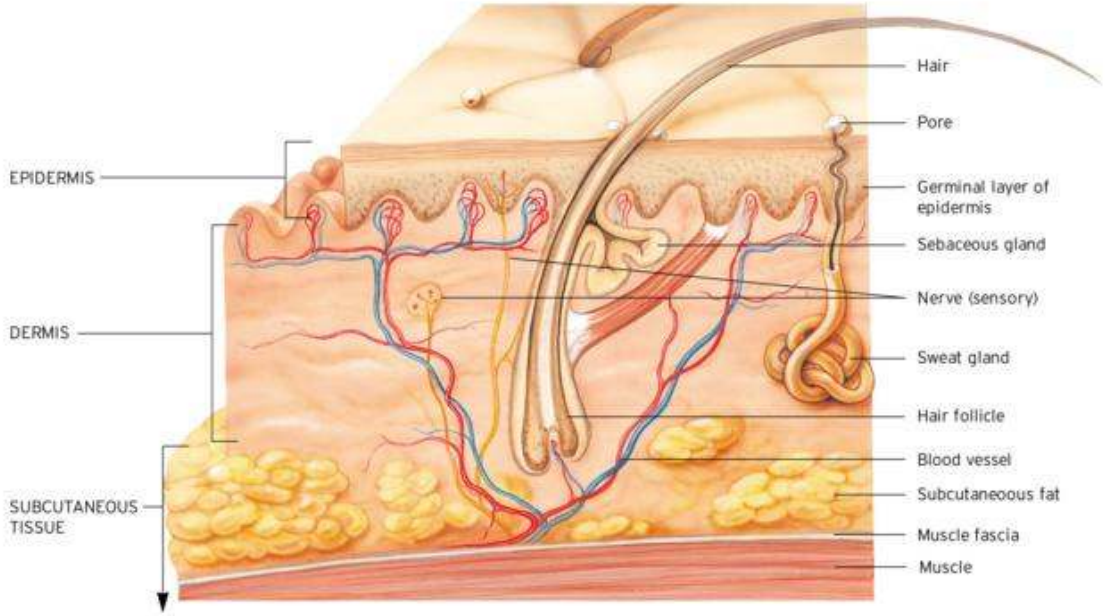
Superficial burn (first degree): involves only the top layer or epidermis. . Characterized by reddened skin, pain, and the absence of blisters. Normally, there is no scaring and the burn heals in about one week

Partial-thickness burn (second degree): affects both the epidermis and the dermis layer. Blisters that may contain or leak clear fluid giving the skin a wet or mottled and swollen appearance. This type of burn is often quite painful, and may take up to a month to heal, leaving some scaring.

Full thickness burn (third degree): destroys all layers of skin and all to some of the fat, muscle, nerves, hair follicles as well as blood vessels under it. Tissue and structures that remain may appear brown or black and leathery. The skin may also appear translucent, mottled, or waxy white and is generally dry. This can be either extremely painful or virtually painless.

The skin's three layers

Epidermis - the top or superficial layer of skin. It provides the first protection barrier against foreign substances. This layer is made up of dead and dying cells that push their way up to the surface.
Dermis - the second, lower layer that may exceed 4mm in thickness at the soles and palms. The dermis layer provides a water and electrolyte reservoir as well as protection against mechanical or compression injuries. Muscle fiber, hair follicles, blood vessels, sweat and oil or sebaceous glands also exist at this level.
Subcutaneous Tissue - serves as insulation made up of adipose (fat) and connective tissue.



General Management

- Ensure personal safety and safety of bystanders
- Routine practices should be utilized as appropriate
- Remove the patient from the burn or radiation source
- Specially trained personnel may be required to access the patient and transport them to a safe environment.
- Remove any burning material
- Consider cervical spine precautions
- Maintenance of an open airway and ensuring adequate respirations has priority over all other treatments including control of the cervical spine
- Calm and reassure the patient
- Primary survey (initial assessment)
  - Establish ABC's
  - Consider an inhalation injury with potential airway compromise if any or all of the following clinical indicators are present
    - History of altered mental status
    - History of confinement in a burning environment (e.g. trapped in a closed fire environment) burns to the head, face, nose, mouth, neck or torso
    - Singed eyebrows and nasal hair
    - Carbon deposits in the nose or mouth
    - Acute inflammatory changes to the oropharynx
    - Carbacceous sputum
    - Stridor
    - Explosion with burns to head and torso
  - Presence of any of these findings suggest acute inhalation injury
    - These injuries require immediate and definitive care and close monitoring for changes in te patient's respiratory status
    - Load and go should be considered if any of these are present
- Administer 100% oxygen and support respirations
- Repeat and record vital signs at regular intervals (5-15 mins.) or when there is a change in the patient's status
- Secondary survey (detailed assessment)
  - Estimate percentage of body surface area injured by using the Rules of Nines
  - Estimate depth of burn
  - Assess for other injuries
- Initial treatment of injuries should be based on the patient's signs and symptoms
- Pay particular attention to the presence of the following injuries, because they are associated with particular complications
  - Direct thermal injury
    - Upper airway edema or obstruction
  - Inhalation of products of incomplete combustion (carbon particles) and toxic fumes
    - Tracheal and bronchial inflammation, edema, and pneumonia
  - Carbon monoxide (CO) poisoning
    - Respiratory distress, chest pain, altered mental status, seizures, coma

- Remove jewelry from any extremity that has been burned if possible, without further injuring the patient
  - Jewelery may need to be cut off in order to remove it
  - Document the disposition of jewelry removed
- Treat burns
  - Do not apply any ointment to a burn
  - Do not break blisters
- Treat for shock, if indicated
- Treat other injuries if the patient's condition permits
- Cold compresses should not be used for pain control
  - Do not continue to apply cool saline or water to the burns once the burning process has been stopped
  - Ongoing application of cold solutions may cause hypothermia
- Maintain high concentration of oxygen delivery to the patient
  - Assist ventilations if required
- Do not allow the patient to exert him/herself - e.g. walking, standing unassisted to transfer to the stretcher, etc.
- Load and go should be initiated if a significant burn is recognized, or there are potentially life-threatening complications due to the burn
  - On scene times should be kept to a minimum
  - Treat other life-threatening conditions en route
  - Use of narcotic analgesics (morphine sulphate/fentanyl citrate) or non-narcotic analgesics (acetaminophen/nitrous oxide) may be appropriate. Please refer to the appropriate Emergency Treatment protocol.
- Transport the patient to the nearest appropriate health care facility
  - Notify the receiving health care facility of the patient's status as soon as possible
  - Monitor and treat the patient en route
  - Additional surveys and treatments should be conducted en route
- Document all actions including the decision to initiate load and go
- Report all findings to the receiving facility staff, and document on the patient care report

Electrical Burns

In any incident involving a car crash into a power pole, look for downed power lines. Sometimes they are hidden from sight by grass or a bush, so look at the next pole down the line. Count the number of power lines at the top cross arm. There should be the same number of lines at the top of the damaged pole. If the number is not the same, then proceed as follows:

- If you suspect that lines are down or the power pole has been weakened, notify all rescue personnel of the possible danger. Then notify the power company and request an emergency crew (this can be accomplished using the provincial Medical Transportation Coordination Center)
- If the soles of your feet tingle when you enter the area, go no farther. You are entering an energized zone.

- Assume that a downed power line is live until the power company crew tells you otherwise. Remember that vehicles, guard rails, metal fences, etc. conduct electricity.

If the patient's vehicle is in contact with a downed power line, tell the patient to stay inside the car. Maintain a safe distance. Never have a patient try to jump clear unless there is an immediate danger of fire or explosion. Do not touch the vehicle and the ground at the same time. If you do, the current can kill you.
Never try to remove a power line. Personnel from the electrical company must do this. They have the training and the proper equipment to handle the line safely.

Electrical hazards and injuries are not specific to Motor Vehicle Collisions. The Paramedic should be aware of this when approaching any scene. If you approach an emergency scene involving other electrical hazards, make a visual sweep for power cords. Pull the plug before you approach or touch the patient. Remember that a power tool does not have to be on to present a shock hazard. In general, you should never try to remove a patient from an electrical source unless you are trained and equipped to do so. Never touch a patient still in contact with an electrical source.
Signs and symptoms of electric shock may include:

- Altered mental status.
- Obvious severe burns.
- Weak, irregular, or absent pulse.
- Shallow, irregular, or absent breathing.
- Multiple fractures due to intense muscle contractions.

Care for a patient with electrical burns the same way you would care for any other patient with burns, however, note that an electric shock can throw a patient a significant distance, as well, tetanic muscle contractions can cause spinal fractures. Therefore, stabilize the patient's head and neck during assessment and treatment. Also, look for both entry and exit burns.

Patients who are victims are susceptible to cardiac dysrythmias and myocardial damage. Therefore, use of 3-lead monitoring is appropriate to monitor for ventricular dysrythmias. The use of 12 or 15 lead monitoring may also be appropriate to rule out reciprocal myocardial damage from the electrical shock. Dysrythmias may be treated using electrical and pharmacological interventions as per the ACLS guidelines (refer to appropriate rhythm protocol).

Lightning Injuries

Thousands of electrical injuries occur each year in the U.S. About 25% of them are lightning injuries. A lightning bolt can pack more than a trillion watts of electricity and up to 100 million volts. Much of the electrical energy from lightning flows around, not through, a strike victim. A patient who has been struck by lightning does not hold a charge, so it is safe to approach him or her.

People are struck by lightning most often in open fields, under trees, on or near water, near tractors and heavy equipment, on golf courses, and at telephones. A person may be struck directly by lightning or lightning may “splash" off a nearby object. Whole groups of people can be affected by a ground strike in which lightning hits the ground and electricity ripples outward.

Most victims of lightning are knocked down or thrown, so assume possible spinal injury. Also, assume that a victim of lightning has sustained multiple injuries. Patients generally sustain the following types of injury:

- The nervous system - In many instances of lightning strike, the patient becomes unresponsive. Few actually remember being struck. Some patients suffer partial paralysis. Occasionally, paralysis of the respiratory system causes death.
- The senses - Some patients experience a loss of sight, hearing, and ability to speak. Rupture of one or both eardrums (tympanic membranes) occurs in 50% of patients who have been struck by lightning.
- The skin - In a lightning burn, the skin may appear to be feathery, patchy, or in a scattered pattern resembling flowers. This is called "ferning". The burn may be red, mottled, blue, white, swollen, or blistered. The ferning fades and disappears within days.
- The heart - The lightning strike itself can disrupt the heart's rhythm, but the complications that follow are what generally lead to full cardiac arrest.
- The vascular system - Within seconds following the lightning strike, the patient may become unresponsive, appear pale and mottled, have cool arms and legs, and lose pulses. If the injury is moderate, the conditions may correct themselves quickly. In case of severe injury, blood may coagulate and tissues in the arms and legs may die, leading to the need for amputation. Kidney failure may result.

Care for lightning burns as you would any other type of burn. You also should provide manual stabilization of the patient's head and neck during emergency care, and be prepared to provide basic life support. Such measures should continue even if the patient appears to be lifeless. Victims of lightning have been resuscitated as long as 30 minutes after a strike without any lasting damage.

Burns can be painful, disfiguring injuries. The care you provide will be vital for the patient's survival. The most critical complication of burns is the most difficult to observe. Burns to the airway can cause swelling and obstruction, which can lead to inadequate breathing or respiratory arrest. Monitor the patient very carefully for these conditions.

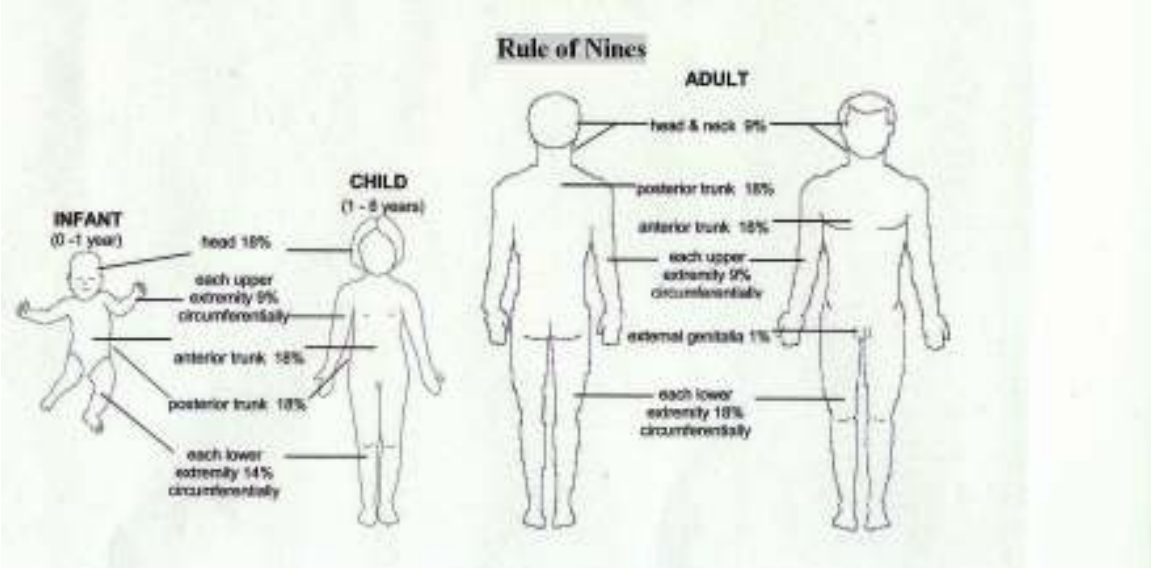
Although myocardial infarction from lightening injuries are uncommon, the patient should have appropriate 3 lead monitoring for ventricular dysrythmias as well as 12 or 15 lead monitoring where available. Dysrythmias may be treated using pharmacological or electrical interventions as outlined in the rhythm appropriate Emergency Treatment Protocols.

Safety is a primary concern. The source of the burn (such as flames or chemicals) and a smoke or vapor-filled environment can be a danger to you as well. Have people who are properly trained and equipped remove the patient from a hazardous scene. Only then begin emergency medical care.

Summary of Special Considerations for Electrical Burns (including lightening)

- Eliminate the electrical contact or shut off the power
- Monitor the patient for possible cardiac arrhythmias
- If the patient is in cardiac arrest
  - Initiate CPR and
  - Defibrillate as per Defibrillation Protocol
- Consider load and go
- Treat as thermal burns
- Consider cervical spine control in primary survey (initial assessment)
- Immobilize if required
- Treat for shock if indicated

Assessment of Burn Area



Radiation Burns

Injury due to exposure to ionizing radiation occurs infrequently. However, the incidence of radiation emergencies has increased in recent years due to the expansion of nuclear medicine procedures and commercial nuclear facilities. Radiation is a general term applied to the transmission of certain types of energy. This energy can include nuclear energy, ultraviolet light, visible light, heat, sound, and X-rays. A radioactive substance emits ionizing radiation. Such a substance is referred to as a radionuclide or a radioisotope. There are four types of radiation. These include:

- **Alpha Particles:** Alpha particles are slow-moving, low energy particles that can usually be stopped by such things as clothing and paper. Because they can be absorbed (stopped) by a layer of clothing, a few inches of air, or the outer layer of skin, alpha particles constitute a minor hazard. However, they can produce serious effects if ingested or inhaled.
- **Beta Particles:** Smaller than alpha particles, beta particles are higher in energy. They can be stopped by aluminum and similar materials. Beta particles generally cause less local damage than alpha particles, but they can be harmful if inhaled or ingested.
- **Gamma Rays**: Gamma rays are more highly energized and penetrating than alpha and beta particles. The origin of gamma rays is related to that of X-rays. Gamma radiation is extremely dangerous, carrying high levels of energy capable of penetrating thick shielding. Gamma rays easily pass through clothing and the entire body, inflicting extensive cellular damage. Protection from gamma radiation can be provided by lead shielding.
- **Neutrons:** Neutrons are more penetrating than the other types of radiation. The penetrating power of neutrons is estimated to be 3-10 times greater than gamma rays, but less than the internal hazard associated with ingestion of alpha and beta particles. Exposure to neutrons causes direct tissue damage. However, in nuclear accidents, neutron exposure is not normally a problem for paramedics because neutrons tend to be present only near a reactor core.

Effects of Radiation on the Body

Ionizing radiation cannot be seen, felt, or heard. Therefore, a detection instrument is required to measure the radiation given off by the radiation source. Simply stated, ionizing radiation causes alterations to the body's cells, primarily the genetic material (DNA). Depending upon the dosage received, cellular division, structure, and biochemical activities can be affected. Cellular damage, due to ionizing radiation, is cumulative over a lifetime. If a person is exposed to ionizing radiation long enough, there will be a decreased number of white blood cells. Additionally, there may be defects in offspring, an increased incidence of cancer, and various degrees of bone marrow damage.

Detection of the first biological effects of exposure to ionizing radiation occurs at varying times. Biological effects include:

- Acute - Effects appearing in a matter of minutes or weeks.
- Long-term - Effects appearing years or decades later.

Limiting radiation exposure is based on three principles: time, distance, and shielding. There are basically two types of ionizing radiation accidents; clean and dirty accidents. In a clean accident, the patient is exposed to radiation but is not contaminated by the radioactive substance, particles of radioactive dust, liquids, gases, or smoke. After exposure to ionizing radiation, the patient is not radioactive. Therefore, he or she poses no hazard to rescue personnel. In contrast is the dirty accident - often associated with a fire at the scene of a radiation accident - exposes the patient to radiation and contaminates him or her with radioactive particles or liquids. Even though the primary source of radiation is shielded when rescue personnel arrive the scene may be highly contaminated. Unless you are properly trained in dealing with this type of emergency, you may have to delay rescue procedures until properly trained technical assistance arrives.

- Radiation Burns require special consideration for treatment
- Ensure personal safety and safety of bystanders.
- As early as possible in the incident, inform the receiving hospital of the nature of the patient's exposure to the radioactive materials so contamination containment procedures and/or treatment preparations can be initiated.

Signs and Symptoms

May include some or all of the following depending upon the length and strength of exposure

- asymptomatic
- nausea, vomiting
- diarrhea, anxiety
- tachycardia
- confusion, ataxia

Special Considerations for Radiation Burns

- Inform the receiving health care facility of the nature of the patient's exposure to the hazardous materials so decontamination procedures (if not done at the scene) and treatment preparations can be initiated
  - Do this as early as possible to permit adequate preparation time at the receiving facility
- An additional ambulance(s) and additional EMS staff may be required to transport the patient if the initial EMS personnel or their ambulance becomes contaminated
- See Poisoning Guideline for Hazardous Material Exposure for safety procedures and emergency contact telephone numbers
  - Specialized assistance may be required
  - Routine Practices should be utilized which includes the use of masks being worn by all attending personnel
  - Consider the patient and everything that comes in contact with the patient including EMS personnel, equipment and ambulances as contaminated
- Remove the patient's clothing and dispose of in appropriate containers
- Treat wounds, burns, and other injuries as indicated

- ❖ Use of decontamination procedures should be implemented, and the appropriate regional EMS authorities notified.

Hot and Cold Emergencies

Temperature Regulation

Core Temperature - is that of the deep organs/structures of the body compared to the temperature of the surface. Core temperature does not vary more than one or two degrees from 37 degrees Celsius. The body maintains its temperature by metabolism.

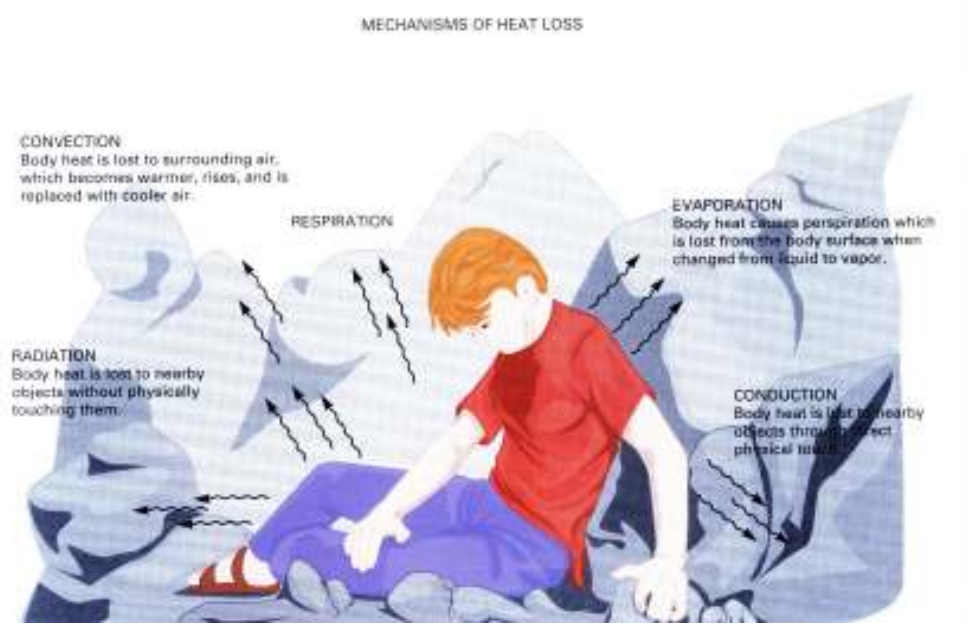
Metabolism - the combination of all chemical processes that take place in living organisms, resulting in growth, generation of energy, elimination of wastes, and other bodily functions as they relate to the distribution of nutrients in the blood after digestion. In short, Metabolism = work = energy = heat.

The hypothalamus section of the brain controls temperature regulation. The thermostat of the brain adjusts as follows:

TOO HOT	**TOO COLD**
Vasodilates	Vasoconstricts
↑ perspiration	↓ perspiration
↓ Heat production	↑ Heat production
↑ Cardiac output	↓ Cardiac output
↑ Respiratory rate	↓ Respiratory rate

Heat Loss occurs in five ways:

Radiation - heat given off by an object like the sun.
Convection - moving air (ex: windchill)
Conduction - heat moving from a greater source of heat to a lesser. For example, a warm body immersed in cooler water.
Evaporation - sweat going from liquid to gas.
Respiration - body temperature air exhaled to environment.



EMS personnel must ensure they provide careful thorough assessment and gentle handling to patients who have suffered cold exposure. Tissue damage and cardiac complications could result from aggressive assessment, treatment, and transport of these patients.

General Management of Cold Related Emergencies Includes:

- Scene assessment for mechanism of injury
- Utilize Routine Practices as appropriate
- Primary survey (initial assessment). Thirty to sixty second assessment of vital signs may be appropriate in the hypothermic patient.
- Consider load and go
  - Particularly if there is evidence of moderate to severe hypothermia, cardiorespiratory or cerebral compromise
- Carefully move patient to a warm environment, if possible
- Do not allow the patient to exert him/herself - e.g. walking, standing unassisted to transfer to the stretcher, etc.
- Initiate transport
  - On scene times should be kept to a minimum
  - Treat other life-threatening conditions en route
- Transport the patient to the nearest appropriate health care facility
  - Notify the receiving health care facility of the patient's status as soon as possible
  - Transport patient in a position of comfort, injuries permitting
  - Monitor and treat the patient en route
  - Additional surveys and treatments should be conducted en route
- Report all findings to the receiving facility staff, and document on the patient care report.

If the heat loss of the body is greater than the heat the body is able to make, hypothermia begins. Stages of hypothermia are as follows:

Chillblains: (1st degree Frostbite) redness and swelling of the skin caused by excessive exposure to cold. Burning, itching, blistering, and ulceration that are similar to that of a thermal burn may occur.

Frostbite: a localized condition in which specific body tissues freeze. It frequently occurs in the lower extremities and may also occur in the ears, nose and other body areas that are unprotected. Water lies in and around the cells. When the water freezes, it causes swelling and ice crystal formation, both of which can damage cells. In most severe cases, gangrene (local tissue death) can lead to the loss of the affected body part.

Superficial frostbite: affects the dermis and shallow subcutaneous layers. Initial signs and symptoms are coldness and numbness in the affected area. This is followed by extreme pain (tingling and throbbing) during re-warming. Affected tissue is sensitive to heat and cold and for unknown reasons remains unusually susceptible to repeated frostbite injury.

Deep frostbite: affects the dermal and sub dermal layers of tissue. The disrupted nutritional capillary flow is never restored to the patient's damaged tissue. The affected area remains cold mottled and blue or grey after re-warming.

Signs and symptoms

- Pale skin with loss of sensation/tingling in affected area.
- Firm or waxy skin.
- Swelling, blistering, loss of sensation.
- Firm, white or grey tissue in severe tissue damage.

Treatment

- Provide dry dressings and passive warmth to affected areas
  - Handle injured parts gently
  - Keep the affected area at rest
  - If the lower limbs are involved do not allow the patient to walk
- Remove all coverings from the injured part(s)
- Protect injured areas from pressure, trauma, and friction
- Do not rub affected areas
- Do not break blisters
- Do not allow the limb to thaw if there is a chance that the limb may refreeze before evacuation is complete or while en route
- Use only passive rewarming
- Maintain the patient's core temperature and prevent further heat los
  - Place the patient in a warm ambulance
  - Wrap the patient with blankets

- Warm fluids may be administered to a fully conscious and oriented patient

Hypothermia

Hypothermia is defined as a state of low body temperature, low core temp of less than 35 degrees Celsius.

Mild hypothermia (34-36 degrees Celsius):

- Involuntary shivering.
- No complex motor function (i.e. skiing) Although able to walk and talk.
- Vasoconstriction of extremities.

Moderate hypothermia (30-34 degrees Celsius):

- Dazed consciousness - apathetic "I don't care"
- Loss of fine motor co-ordination due to restricted blood flow in hands.
- Slurred speech and violent shivering.
- Irrational behavior - person starts to take off clothes. Does not feel the cold temperatures.

Severe hypothermia (< 30 degrees Celsius):

- Shivering in waves, with pauses that increase to the point of no shivering. The body can no longer produce heat through metabolism to combat the falling temperatures.
- Patient assumes a fetal position to conserve heat.
- Rigidity in muscles.
- Skin is pale.
- Pupils dilate.
- Pulse rate deceases.
- At approx. 32 degrees Celsius, the body moves into a hibernation-type state.
- At 30 degrees Celsius the body appears dead, but may still be alive.

Treatment

- A thirty to sixty second assessment may be needed to determine if a pulse or respirations are present
- Maintain high concentration oxygen delivery to the patient
  - Assist ventilations if required
  - Oxygen should be warmed and humidified, if possible
- Consider load and go, particularly when there is evidence of cardiorespiratory or cerebral compromise
- Move patient to a warm environment, if possible
- Provide dry dressings and passive warmth to affected areas
- To prevent further deterioration in the patient's condition
  - Remove wet clothing from the patient
  - Maintain the patient in a warm, draft free environment
- Maintain the patient's core temperature and prevent further heat loss
  - Place the patient in a warm ambulance
  - Wrap the patient with blankets

Note

- Core temperature can only be assessed by a rectal thermometer or suitable alternative method
  - An oral or tympanic thermometer is not suitable to determine core temperature in the hypothermic patient
- Active rewarming for patients with cold emergencies should be left until arrival at the health care facility
- Patient should be wrapped in blankets to prevent further cooling and to allow for passive rewarming
  - Do not use electric blankets
- Assessment of vital signs in hypothermic patients should be done for a longer time because heart rate and respirations may be slowed
  - It may also be more difficult to detect pulses or chest movements if the tissues are cold or rigid
- When assessing the patient to determine whether they meet the criteria for the determination of death, a hypothermic patient should be assessed carefully
  - Do not withhold resuscitative efforts unless there are reasons (other than hypothermia) to withhold resuscitation
  - If there is any doubt whether these patients meet the criteria, full resuscitative measures should be initiated
  - In general, patients are not determined to be dead unless they are "warm and dead" because severe hypothermia may mask all signs of life
- The absence of a pulse in a hypothermic patient is not a reliable indication of cardiac activity
- To avoid the possibility of inducing ventricular fibrillation to a cold but functioning heart, handle hypothermic patient s with care.
- Functional cardiac activity is considered to be absent if

- The patient with a palpable pulse loses a palpable pulse during evacuation or
- No clinical signs of life are present
  - No spontaneous ventilation
  - No response to assisted ventilation
  - No spontaneous movements or sounds
  - No organized rhythm on a cardiac monitor
  - No audible heart sounds on auscultation

❖ Always consider the possibility of hypothermia in an elderly patient with an altered level of consciousness
- Hypothermia may develop in elderly patients in an environment which is "cool" and not necessarily "cold"
- Signs and symptoms of hypothermia in the elderly may include
  - Irregular or slow heart rate
  - Shallow, irregular, or slow respirations
  - Low blood pressure
  - Absence of shivering, but skin feels cold to the touch
  - Facial bloating
  - Pale and waxy skin color
  - Slurred speech
  - Altered level of consciousness

❖ Shivering usually occurs between 36.6 ^{0} to 32^{0} Celsius, but not usually below this temperature
- Presence or absence of shivering is a fair indicator of the severity of hypothermia in a patient

❖ Moderate to severe hypothermic patients in cardiac arrest should be managed based on current treatment guidelines and protocols
- Some exceptions do exist with the hypothermic patients
  - If the core temperature is less than or equal to 30^{0} Celsius
    - Defibrillate once if shock advised, at 360J or biphasic equivalent
    - Further defibrillation attempts can be made if core temperature rises above 30^{0} Celsius
    - Withhold intravenous cardiac arrest medications (lidocaine etc.)
  - If the core temperature is greater than 30^{0} Celsius
    - Repeat defibrillation as indicated
    - If EMS personnel are trained and certified, intravenous cardiac arrest medications can be used

❖ In rescue situations, EMS personnel should be prepared to treat rescue personnel for hypothermia
- Additional resources should be requested during the initial scene assessment if they might be required

Core Body Temperature and Resultant Physiologic Changes

^{0}F	^{0}C	Physiological Changes and Responses Due to Decreasing Core Body Temperature
99.6	37.6	"Normal" rectal temperature.
98.6	37	"Normal" oral temperature.
96.8	36	Increased metabolic rate in attempt to balance heat loss.
95.0	35	Shivering maximum at this temperature.
93.2	34	Patients usually responsive and normal blood pressure.
91.4	33	Decreasing levels of consciousness may be noted.
89.6	32	Decreased level of consciousness; pupils dilated; shivering ceases.
78.8	31	Blood pressure difficult to obtain.
86.0	30	Progressive loss of consciousness, increased muscular rigidity. Severe hypothermia below this temperature.
85.2	29	Slow pulse and respirations; cardiac arrhythmia develops.
82.4	28	Ventricular fibrillation may develop if the heart is irritated.
80.6	27	Voluntary motion lost along with pupillary light reflex, deep tendon and skin reflexes – appearance of death.
78.8	26	Victims seldom conscious.
77.0	25	Ventricular fibrillation may appear spontaneously.
75.2	24	Pulmonary edema develops.
73.4	23	
71.6	22	Maximum risk of fibrillation.
69.8	21	
68.0	20	Heart standstill.
66.2	19	
64.4	18	Lowest accidental hypothermic patient with recovery in Manitoba
51.2	14	Lowest accidental hypothermic patient with recovery in Saskatchewan (1994)

Hyperthermia

Hyperthermia: abnormal excess in body temperature.

Heat related emergencies range from minor problems requiring on scene supportive treatment to true life threatening emergencies. EMS personnel must initiate appropriate interventions as early as possible.

General Managment Includes:

- Utilization of Routine Practices and equipment as appropriate
- Scene assessment – note environmental factors, including temperature and humidity
- Primary survey (initial assessment)

- Secondary survey (detailed assessment) including
  - Vital signs
  - Skin temperature
  - Skin condition and color
  - Accurate history, including conditions affecting symptom onset and rapidity of symptom onset
- Do not allow the patient to exert him/herself – e.g. walking, standing unassisted to transfer to the stretcher, etc.
- Initiate transport
  - On scene times should be kept to a minimum
  - Treat other life-threatening conditions en route
- Transport the patient to the nearest appropriate health care facility
  - Use of Intravenous fluids (Normal Saline or Ringers Lactate) may be indicated, as the patient is often dehydrated and requires re-hydration through intravenous fluids. Titrate based on hemodynamic stability. This will aid in the replacement of fluids and electrolytes that are lost during the body's natural process of releasing heat.
  - Notifiy the receiving health care facility of the patient's status as soon as possible
  - Monitor and treat the patient en route
  - Do not allow chilling or overcooling of the patient
  - Additional surveys and treatments should be conducted en route
- Report all findings to the receiving facility staff, and document on the patient care report

The three most common heat emergencies and their special considerations are found below:

Heat Cramps: are acute painful spasms of the voluntary muscles following strenuous activity in hot environments without adequate fluid or salt in-take. Heat cramps are caused by a rapid change in extra cellular fluid from a low concentration to a high concentration, resulting from sodium and water losses. Sweating occurs as sodium is transported to the skin's surface.

Signs and Symptoms of Heat Cramps May Include

- Profuse sweating
- Painful spasms of voluntary muscles and abdomen after strenuous exercise or exertion in a hot environment
- Weakness
- Physical examination and vital signs may otherwise be normal

Treatment

- Move patient to a cool, shaded environment
- Position patient supine or in recovery position
- Transport, monitor, and maintain a cool environment

Heat exhaustion: is an acute reaction to heat exposure. Blood pools in the vessels as the body attempts to give off excessive heat. It can lead to collapse due to inadequate blood return to the heart. An individual performing work in a hot environment will lose up to 1-2 litres of fluid an hour. The loss of water and sodium, combined with general vessel dilation (vasodilation), leads to a decreased circulating blood volume, venous pooling and reduced cardiac output.

Signs and Symptoms of Heat Exhaustion May Include

- Headache
- Dizziness
- Nausea
- Cramps
- Generalized weakness
- Weak, rapid pulse
- Shallow, rapid respirations
- Normal or decreased blood pressure
- Cool, pale, moist skin
- Profuse sweating
- Disorientation
- Decreased level of consciousness or unconsciousness

Treatment

- Maintain high concentration oxygen delivery to the patient
  - Assist ventilations if required
- Move patient to a cool, shaded environment
  - Remove excess clothing from the patient
  - Position patient supine with feet elevated, if possible, or in recovery position
  - Cool the patient gradually by sponging front and back of patient with lukewarm water, if possible
  - Avoid overcooling
- If shivering is provoked, dry the patient
- Load and go should be initiated
- Transport, monitor and maintain a cool environment

Heat stroke: is a true life-threatening emergency. Heat stroke is sometimes called sunstroke, although the sun is not required for its onset. Heat stroke commonly occurs during hot weather. It results when the body loses its ability to cool itself sufficiently. The body becomes overheated with temperatures rising to 41degrees Celsius. No sweating occurs in about half the patients. Because no cooling takes place, the body begins to store more and more heat. Eventually, brain cells are damaged, causing permanent disability or death.

Signs and Symptoms of Heat Stroke May Include

There are two main types of heat stroke:

Classical Heat Stroke

- Failure to sweat in response to increased temperature due to dehydration resulting in an increase in the body's temperature and subsequent damage to body cells.

Exertional Heat Stroke

- Physical exertion in an environment with high temperatures and high humidity which prevents evaporative cooling of the body resulting in an increase in the body's temperature and subsequent damage to body cells.

Signs and Symptoms May Include

- Disorientation
- Hot, flushed, dry skin (classic heat stroke) or hot, flushed, diaphoretic skin (exertional heat stroke)
- Elevated body temperature
- Signs and symptoms of shock
- Rapid, bounding pulse or rapid, weak pulse
- Respirations initially deep and rapid progressing to shallow and ultimately respiratory arrest
- Blood pressure initially may be high but may drop rapidly
- Dilated, sluggish pupils
- Seizures
- Stroke
- Delirium
- Stupor
- coma
- Increased core temperature.
- Altered mental status/CNS disturbance.
- No sweating.
- Dry mouth.
- Headache.
- Tachycardia followed by bradycardia.
- Hypotension with low or absent diastolic pressure.
- Initial deep, rapid, breathing that becomes shallow and weak.
- Muscular twitching, seizures.
- Loss of consciousness, coma.

Treatment

- This is a life-threatening emergency
- Establish ABC's
- Maintain high concentration oxygen delivery to the patient
  - Assist ventilations if required
- Move patient to a cool, shaded environment

- Initiate load and go
  - Position patient in the recovery position facing the attending EMS personnel, if possible cool the patient rapidly
  - Remove excess clothing from the patient
  - Wrap the patient in a sheet and saturate it with cool water
    - Ensure there is no electrical hazard
  - Place the patient so the flowing air can crate air currents over the patient to promote cooling
    - Avoid over stimulation of the patient by placing the patient in direct contact with cold packs or cold source
- Monitor for seizures
- Treat for shock, if required
- Transport the patient to the nearest appropriate health care facility
  - Any additional surveys should be conducted en route
  - Do not allow the patient to shiver, become chilled, or overcooled

Note

- Not all heat emergencies are environmental in nature
  - The patient's condition may have an infectious or neurological etiology
- High body temperature may cause seizures, particularly in infants (follow Seizure Emergency Treatment Guideline – as outlined by Manitoba Health)
- Rapid cooling may cause vomiting or shivering
  - Do not continue cooling if shivering starts
  - Dry the patient and remove the cooling material
  - Monitor the patient

Bites and stings

When dealing with bites or stings, it is important to keep your safety a number one priority. Is the scene safe? Animal bites can cause major trauma to a human. Bleeding may range from profuse to little to none at all. Bites may cause local or systemic reactions. Keep in mind you must start with the basics; ABC's, bleeding and c-spine. Keeping the wound(s) as clean as possible is the next priority by rinsing/cleaning with saline and wrapping the wound in clean/sterile dressings and bandages. Remove any constricting objects, such as jewellery, as soon as possible. At this point in care, have a high concern for infection and disease transfer from the animal to the patient. Apply a cold pack and keep patient calm, warm, and limit physical activity. Continue to monitor ABC's and watch for signs of allergic reaction. As with all history taking, find out what kind of animal was involved. If the animal was a domesticated pet, find out if it's vaccinations are up to date. What kind of behavior did the animal display? Consider having police or animal control attend.

Stings from insects also cause local or systemic reactions. Most stinging insects inject venom into the body. There are also key differences between insects. For example,

honeybees only sting once because of their barbed stinger. The stinger and venom sac are left behind in the patient. Wasps or hornets have no barbs on their stinger and as a result are able to sting multiple times. Finding out from the patient what stung them, how many times, previous exposures and history of allergic reactions is imperative. Most importantly, the flow of venom into the body must be stopped. One way to accomplish this is to use a credit card to scrape the stinger off. Follow your MB Health Treatment protocols to deal with potential anaphylaxis situations.

Anaphalatic Shock –a rapidly developing, life-threatening condition that results from an allergic reaction to an allergen. (ex: bite or sting). The diagram below illustrates the signs and symptoms of an allergic reaction. It is important to appreciate that the victim may have some or all of these symptoms, but a true anaphylactic emergency is when it becomes a life threatening reaction.

Special Considerations for Bites and Stings

Snake Bites

- Ensure safety for EMS personnel
  - If there is any question regarding the presence of the snake, EMS personnel should not enter the environment until declared safe
  - EMS personnel should not place themselves at risk in attempting to identify the type of snake
- As early as possible in the incident inform the receiving health care facility of the nature of the incident, the type of snake involved, and location(s) of bites so treatment preparations can be initiated
- Do not place cold packs over injury site
- Treat for shock if required
- If an extremity is involved
  - Place a wide non-constrictive band proximal to the injection site
    - The band's purpose is to impede lymphatic flow; it should not impede blood flow
  - Place the band approximately 5 cm (2 inches) proximal to the injection site
    - Do not place a band over a joint
    - Ensure the band is loose enough so that the EMS personnel can slide one finger under the band

Animal and Human Bites

- Treat as per Soft Tissue Injuries/Wounds, External and Internal Bleeding Guidelines

Insect Stings

- Ensure safety for EMS personnel
  - If there is any question regarding the presence of the stinging insect, EMS personnel should not enter the environment until declared safe

- EMS personnel should not place themselves at risk in attempting to identify the type of stinging insect

❖ Care must be taken to ensure no stinging insects remain in the patient's clothing or hair
- EMS personnel must take precautions to ensure they are not stung during assessment of the patient

❖ Identify all injection sites
❖ Where applicable, remove stinger(s) or attached venom sac(s) gently, without squeezing
❖ Monitor vital signs
- Be prepared for possible respiratory difficulty

❖ Be prepared for signs and symptoms of anaphylaxis
- Treat as per anaphylaxis treatment protocols, as required

Epinephrine

Epipen auto-injector

Generic Name: Epinephrine

Trade Name: EpiPen Auto-Injector

Class: sympathomimetic

Action: bronchodilator, peripheral vasoconstrictor, stops leakage from blood vessels, effects occur within seconds of administration.

Indications: anaphylaxis

Contraindications: patient age less than one year, no spontaneous pulse and respirations.

Precautions: Should be protected from light. B/P pulse and ECG must be constantly monitored. Special precautions should be given to patients with serious underlying cardiovascular disease, hypertension and pregnancy.

Side effects: palpitations, anxiousness and headache, increased heart rate, pale skin, chest pain, arrhythmias, nausea and vomiting, increased BP, and dilated pupils.

Drug interactions: There may be increased difficulty in treating an allergic-type reaction in patients currently on beta-blockers.

Duration of action: 20 minutes

Dosages and Administration:

Epinephrine

- Age 1-5 - 0.15 mg subcutaneously, using EpiPen junior or an equivalent device.
- Age 6 or older - 0.3 mg subcutaneously, using EpiPen or an equivalent device.
- Dose may be repeated 15 minutes after initial dose, for persistent or recurrent symptoms.

Diphenhydramine (Benadryl)

Class:

- antihistamine, anticholinergic,

Mechanism of Action

- blocks cellular histamine receptors
- decreases vasodilation
- decreases motion sickness
- reverses extrapyramidal reactions

Indications

- signs and symptoms of anaphylaxis

Contraindications

- patient age less than one year or lack of spontaneous pulse or respirations

Adverse Reactions

- sedation, hypotension, seizures, visual disturbances, vomiting, urinary retention, palpitations,dysrhythmias, dry mouth and throat
- paradoxical CNS excitation in children

Drug Interactions

- potentiates effects of alcohol and other anticholinergics
- MAOIs prolong anticholinergic effects of diphenhydramine

How Supplied

- tablet: 25, 50 mg
- capsules: 25, 50 mg
- 50 or 100 mg prefilled syringes, vials (IV or IM)
- elixir 12.5 mg / 5 ml

Dosage and Administration

- Intramuscular – 2.5mg/kg to max of 100mg
- Intravenously – 1.0mg/kg to max of 50mg

Duration of Action

- onset: 15-30 minutes
- peak effect: 1 hour
- duration: 3-12 hours

Special Considerations

- if used in anaphylaxis, often used in conjunction with epinephrine and steroids

Procedure

- Initiate ABC's – High Flow O_2.

- Perform patient assessment, and record vital signs and LOC.
- Confirm that the patient meets protocol criteria.
- Administer epinephrine.
- Administer diphenhydramine
- Administer salbutamol (if severe Bronchospasm present)
- Transport.
- Monitor/re-assess.
- Repeat epinephrine if required.
- Notify receiving ER of patient status.

Documentation Requirements

- Patient's presenting S & S.
- Indications for protocol use.
- Verbal parental consent in cases of minors.
- Doses, times and effects of administration.
- Changes that occurred from first pt contact to arrival at destination.
- Signature/license number of Emergency Medical Attendant for this T.O.F.

Diagnostic Procedure and Interpretation of Non-Invasive Temperature Monitoring

Skin temperature may be normal (warm), hot, or cold. Skin that is hot to the touch indicates a possible fever or heat-related illness or injury. Cold skin may indicate decreased tissue perfusion and cold-related illness or injury. Evaluations of body temperature may have specific applications in emergencies, such as febrile seizures and hyperthermic and hypothermic emergencies.

Many EMS services use tympanic membrane thermometers or electronic thermometers that obtain readings within seconds. With a standard thermometer, temperature readings are obtained by placing the thermometer under the conscious patient's tongue for 4 to 6 minutes, under the patient's armpit for 10 minutes, or in the patient's rectum for 5 to 8 minutes. (Rectal readings provide the most accurate assessment but may be impractical for prehospital use.) Normal body temperature is 37^0C. Standard clinical thermometers record body temperatures from 34.4^0C to 40^0C. Normal body temperature for an oral location is 37^0C, for a rectal temperature is 37.6^0C and for an axillary location is 36.4^0C.

The procedure for using a tympanic thermometer is as follows:
- Remove thermometer from case
- Check the window located at the end of the probe to ensure that it is clean. If the window is dirty, inaccurate lower temperature readings may be obtained. Clean with alcohol swab if necessary and allow to dry for 5 minutes.
- Install a cover on the probe tip.
- Note the display reads ready.
- Stabilize the patient's head prior to inserting the thermometer:

- Infants - child lying flat in the supine position with the head turned 90 degrees for easy access to ear
- Younger children - child sitting on an adult's lap with the child's head held against the adult's chest for support
- Adults and older children - lying, sitting, or standing with patient cooperation providing stabilization of the head

- In order to have the temperature probe aimed at the eardrum (and not the wall of the ear canal), the attendant pulls the pinna (the external ear) to straighten the ear canal prior to thermometer insertion. With the free hand, the attendant grasps the ear pinna and pulls in the following direction:
  - back and up (adults)
  - back and down (young children)
  - straight back (babies under 12 months)
- Gently insert the thermometer probe following the natural path of the ear canal and as far as possible (until the ear canal is fully sealed off by the probe).
- Holding the thermometer steady, the attendant depresses the activation button and holds until it beeps.
- Remove the thermometer from the patient's ear, and read the temperature.
- Dispose of probe cover by depressing the eject button and return thermometer to case
- Record temperature on PCR

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