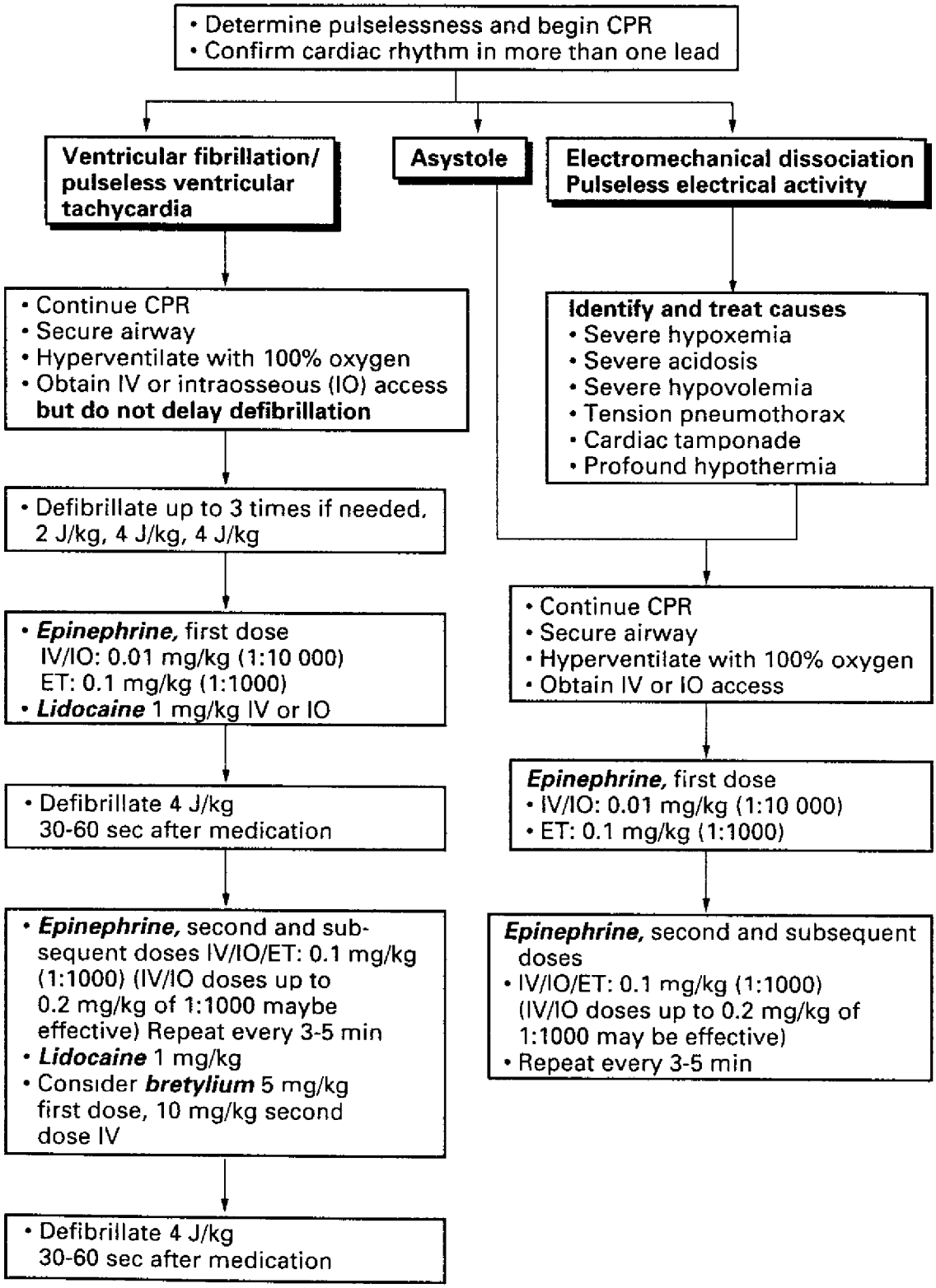
Asystole and Pulseless Arrest Decision Tree

Pediatric Advanced Life Support



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Chemical Burns

MECHANISM OF INJURY

Various chemicals, corrosives (acids and alkalies) can cause tissue damage ranging from skin irritation to severe burns. The liquefaction necrosis effect of alkalies (depending on concentration and other factors) generally produces more tissue damage than acids. Hydrofluoric (HF) acid is an exception.

SIGNS AND SYMPTOMS

Skin—Irritation, redness, vesicle formation, rash, partial- and full-thickness burns may result. Some chemicals (e.g., HF) may cause burns as deep as and including bone.

BASIC TREATMENT

- Ensure that patient is decontaminated. Remove all clothing, shoes, and jewelry. Wash the patient with soap and water.
- Ensure an open airway and support respirations if necessary.
- Check for singed nasal hair, presence of carbon particles, or oral burns.
- Administer oxygen at 10 to 15 L/min by nonrebreather mask.
- Assess and treat any other injuries.
- Estimate body surface area (BSA) of the burn:
  - Rule of Nines: BSA is divided into 11 areas of 9% each plus the perineum at 1%; or use
  - Lund and Browder Chart: BSA map that corrects for age.
- Cover burned areas with dry sterile dressings.
- Maintain body temperature with blankets. Do not apply external heat.
- Evaluate for systemic toxicity and, if substance is known, treat by specific guideline.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation at earliest indicated moment if signs of stridor or respiratory distress are present
- Start an IV of lactated Ringer's or normal saline at TKO rate.
- Depending on the surface area of the burn and the hemodynamic state of the patient, administer fluids according to the Parkland formula (4ml/kg/% BSA burn), administering ½ of the estimated IV fluid volume required during the first 8 hours; consult medical control.
- If no respiratory distress or trauma, consider the administration of morphine sulfate as an analgesic, direct physician order only. (Refer to morphine sulfate protocol in Section Four.)

SPECIAL CONSIDERATIONS

- For ocular burns, refer to eye irrigation protocol in this section.
- Refer to calcium gluconate gel protocol in Section Four for treatment of hydrofluoric acid burns.
- Cover imbedded fragments of water-reactive metals such as sodium, lithium or magnesium with a light cooking oil to help reduce possible tissue reaction.
- Immerse imbedded fragments of phosphorous in water or cover with moist sterile dressings during transport.
- Do not use any topical antibiotic or anesthetic ointments on burn area.
- Routine use of prophylactic antibiotics is not recommended.
- Refer to decontamination protocol in this section.

Decontamination

INDICATIONS

- Limit tissue damage and absorption and prevent systemic poisoning.
- Confine contamination to a specified area.
- Prevent secondary contamination of EMS and hospital personnel.

SITE PREPARATION

- Identify the product, life threat, and route of exposure.
- Establish a controlled access system with an entry and exit point.
- Establish at a minimum a two-stage decontamination area that is upwind and uphill from the contaminated area and away from environmentally sensitive areas. Take into consideration the distance from contaminated area; if distance is great, transportation may be required (i.e., a pickup truck).
- The first decontamination stage is clothing removal/water rinse. The second stage consists of a soap and water wash and rinse (if a more extensive decontamination process is necessary, refer to resource data sources and on-scene specialists).
- Hospital decontamination can be conducted outside the Emergency Department (ED) using portable equipment. An alternative to outside decontamination is a specially designed room with a separate entrance, contained drains, and separate ventilation system.
- Proper protective equipment is necessary for patient care during decontamination operations. **Responders should not attempt to use protective equipment without proper training and fit testing as required. Equipment selection should be performed by an informed, knowledgeable individual using appropriate reference materials.**

AMBULATORY PATIENT PROCEDURE

- Have patients exit the contaminated area.
- Provide shelter and assist patients if necessary in quickly removing clothing, jewelry, and shoes. Isolate these items. If assisting, wear positive-pressure self-contained breathing apparatus (SCBA) and protective equipment specified by references such as the *DOT Emergency Response Guidebook* or the *CANUTEC Initial Emergency Response Guide.* If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Have patient carry out the following procedures (properly protected responders should assist if necessary).

  Gently brush off solid or particulate contaminants as completely as possible before washing to reduce the likelihood of a chemical reaction with water Blot visible liquid contaminants from the body with absorbent material before washing. Use care not to cause any tissue damage.

  Rinse patient with copious amounts of water. If possible, use warm water, 30° C/ 86° F) so that extensive washing can be accomplished. There is a high risk of hypothermia if cold water is used. Never use hot water. Use low water pressure and a gentle spray to avoid aggravating any soft tissue injuries. Avoid overspray and splashing.

Use gentle running water from midline to lateral face for eye decontamination. Remove contact lenses if possible. For removal of contact lens and emergency eye care, refer to eye irrigation protocol in this section.

Wash patient with Tincture of Green soap or a mild liquid soap. Liquid soaps dispensed from small squeeze bottles work very well. Pay special attention to hair, nail beds, and skin folds. Soft brushes and sponges may be used. Be careful not to abrade the skin, and use extra caution over bruised or broken skin areas. Damaged skin areas can enhance the dermal absorption of toxic products.

Rinse patient with copious amounts of water. In some cases a special rinse may be beneficial (refer to on-scene expertise and standard operating procedures).

Contain runoff if possible and feasible. Small children's wading pools, commercially manufactured units/tables, draft tanks, or improvised plastic/frame units may be useful. If no containers are immediately available, try to channel runoff to a containment area. Patient decontamination should not be delayed to obtain containment pools.

Protect patient from hypothermia.

- Ambulatory patient self-decontamination should be supervised by EMS personnel to ensure adequate decontamination.

NONAMBULATORY PATIENT PROCEDURE

- Wear positive-pressure SCBA and protective equipment specified by references such as the *DOT Emergency Response Guidebook* or the *CANUTEC Initial Emergency Response Guide*. If special chemical protective clothing is required, consult the chemical manufacturer or specific protective clothing compatibility charts.
- Delay entry until equipment is available.
- Remove patient from contaminated area.
- Quickly remove and isolate patient's clothing, jewelry, and shoes.
- Brush off solid or particulate contaminants as completely as possible before washing to reduce the likelihood of a chemical reaction with water. Blot visible liquid contaminants from the body with absorbent material before washing. Use care not to damage skin.
- Rinse patient with copious amounts of water. If possible, use warm water, 30° C/ 86° F, so that extensive washing can be accomplished. There is a high risk of hypothermia if cold water is used. Never use hot water. Use low water pressure on hose lines to control the spray and avoid aggravating any soft tissue injuries. Avoid overspray and splashing.
- Use gentle running water from midline to lateral face for eye decontamination. Remove contact lenses if possible. For removal of contact lens and emergency eye care, refer to eye irrigation protocol in this section.
- Wash patient with Tincture of Green soap or a mild liquid soap. Liquid soaps dispensed from small squeeze bottles work very well. Pay special attention to hair, nail beds, and skin folds. Soft brushes and sponges may be used. Be careful not to abrade the skin, and use extra caution over bruised or broken skin areas. Damaged skin areas can enhance the dermal absorption of toxic products.
- Rinse patient with copious amounts of water. In some cases a special rinse may be beneficial (refer to on-scene expertise and standard operating procedures).

- Contain runoff if possible and feasible. Small children's wading pools, commercially manufactured units/tables, draft tanks, or improvised plastic/frame units may be useful. If no containers are immediately available, try to channel runoff to a retention area. Patient decontamination should not be delayed to obtain containment pools.
- Protect patient from hypothermia.

DECONTAMINATION ORDER

- Decontaminate head and face first. Brush or blot visible contaminants away from mouth and nose, and then soap/rinse in the same manner. Isolate patient's airway with oxygen mask, bag-valve mask or SCBA as soon as possible.
- Decontaminate areas of skin damage or gross contamination next.
- Take care not to allow contamination into areas of tissue damage. Gently covering areas of tissue damage with a plastic cover/wrap help prevent this.
- Decontaminate rest of body as necessary.

PREHOSPITAL DECONTAMINATION CONCEPTS

- Decontaminate in the warm zone, before transport, with simultaneous patient care by protected responders.
- Emergency medical decontamination is usually considered as a primary procedure to stop the chemical action on the patient and allow for safe care and transport. In other words, the purpose of emergency decontamination is to get the patient as clean as reasonably possible, depending on scene conditions and patient presentation. If time, patient presentation, and scene conditions permit, a secondary, detailed decontamination procedure may be carried out This secondary process, may be better carried out at a prepared and properly equipped hospital receiving emergency department.
- Hospitals are poor choices for primary decontamination. The chemical continues to effect the patient during transport. Transport vehicles and personnel may also become contaminated.
- In inclement weather, use the inside of a cargo truck/trailer, or specially prepared stationary ambulance (walls and floor covered by plastic sheeting, nonessential equipment removed) for decontamination. Other shelters (e.g , local facilities such as schools, firehouses, garages, and indoor car washes may be used after initial rinse at scene for thorough decontamination. Remember that transport personnel, vehicles, and facility used are contaminated. Another problem associated with indoor facility use is containment of runoff. Consult with local water authorities for assistance.
- Because of the high probability of hypothermia, have sheets and blankets available to cover nonambulatory patients. Supply blankets, disposable clothes or scrubs, and footwear for ambulatory patients after decontamination.
- Decontaminated patients should be transferred to a clean backboard or scoop stretcher to triage or to a noncontaminated transport team in the cold zone.
- Equipment and the transport ambulance should be isolated until complete decontamination can be ensured. All potentially contaminated articles should be isolated for proper disposal according to local, state, and federal regulations. See transportation procedure in Section Five for further guidance on transportation concerns.

HOSPITAL/CLINIC DECONTAMINATION CONCEPTS

- Emergency departments should have decontamination capability. Contaminated patients may arrive at the emergency department without going through EMS channels. Contamination may be missed initially, or a secondary, detailed decontamination may be necessary.

- Decontaminated patients should be passed to noncontaminated personnel on a clean backboard, scoop stretcher, or bed.
- Protective equipment should be used in conjunction with adequate ventilation that moves contaminates away from responders' breathing zone.
- In cases of secondary decontamination procedures, a lesser degree of protective equipment may be adequate. This decision should be made by a knowledgeable individual and based on the nature of the chemical threat and available ventilation.
- The equipment and room should be isolated until complete decontamination can be ensured. All potentially contaminated articles should be isolated for proper disposal according to local, state, and federal regulations.

DECONTAMINATION DECISIONS

- Consider
  - Potential toxicity
  - Nature of chemical
  - State of matter
  - Concentration of the product
  - Route of exposure
  - Duration of the exposure
  - Potential for secondary contamination
- Examples of agents with low risk of secondary contamination
  - Gases (simple asphyxiants, carbon monoxide): Some gas exposures may react with skin moisture and create acid or alkali conditions (e.g., chlorine, anhydrous ammonia) and need to be decontaminated for the care of the patient.
  - Inhalation only: exposure to volatile liquid or vapor. Be aware of any concurrent liquid or solid exposures.
- Examples of agents with high risk of secondary contamination
  - Corrosive products
  - Asbestos
  - Highly toxic products (cyanide salts)
  - Methemoglobin formers (nitrates, nitrites)
  - Pesticides/herbicides
  - High-viscosity liquids (phenols)
  - Oily or adherent products
  - Dusts and powders
  - Radioactive liquids and dusts
- Exposure considerations
  - Over 11 million chemicals listed in the Chemical Abstract Service (CAS)
  - Large amount of product
  - Continuing effect on patient
  - Flammable products may cause fire hazards
  - If any visible product or odor remains on patient
  - **WHEN IN DOUBT, DECONTAMINATE!!**

RADIATION INCIDENT CONCERNS

- Transportation incidents where radioactive materials are the only significant hazard may present a special decontamination concern.

- Packages for large-quantity shipments are designed to withstand accident conditions and as such are unlikely to release their contents. Small-quantity shipments (such as a medical imaging isotope) are more likely to be involved in a radiation release. Life-threatening conditions from the radioactive material released in these situations is unlikely. Trauma is a much greater risk.
- Prolonged field decontamination of patients with life-threatening injuries may delay needed trauma care.
- Effective, complete decontamination may require radiologic monitoring equipment that may not be available in the field.
- Most important, improper decontamination methods may facilitate internalization by transferring contamination to areas of tissue damage or by converting contaminants to a form that could be more readily absorbed through the skin.
- Decontamination for victims of transportation accidents where releases of small quantities of radioactive materials are the only significant hazard should include:
  - Patients with electromagnetic radiation (gamma) exposure, when removed from the area of contamination, require no further decontamination. For patients with particle or liquid exposure, follow the remainder of this section.
  - Quickly remove and isolate patient's clothing, jewelry, and shoes.
  - Package the patient using reverse isolation procedures such as transportation bags, plastic, or blankets. This helps prevent the spread of contamination during transport.
  - Provide adequate ambulance ventilation (properly operating intake and exhaust fans of proper size).
  - Use adequate EMS personnel protective equipment if available. See EMS/hazardous materials equipment procedure in Section Five.
- Notify the emergency department that a potentially contaminated patient is enroute and supply them with all available information concerning the identity and nature of the contaminant.
  - Complete decontamination should be carried out at the emergency department, guided by radiologic monitoring devices and under the direction of a physician and/or health physicist.
  - Exercise extreme care to keep contaminants away from areas of tissue damage and body cavity openings.
- Assistance and advice on patient decontamination and management concerns may be obtained from the Oak Ridge Radiation Emergency Assistance Center and Training Site, 24 hours a day by calling (615) 576-3131 or (615) 481-1000 and ask for Reacts Team.
- **In transportation incidents involving a large-quantity shipment that has sustained a container breech, or a large release at a fixed facility, or if other chemical contaminants besides radioactive materials are suspected, standard field and emergency department decontamination guidelines should be followed.**

Eye Irrigation

MECHANISM OF INJURY

Chemical exposure may cause damage to the eyes, ranging from chemical conjunctivitis to severe burns.

SIGNS AND SYMPTOMS

Eyes—Local pain, visual disturbances, lacrimation, edema, corneal abrasion, corneal lacerations, and redness

BASIC TREATMENT

- Flush with water. Use a low pressure flow from a hose, or pour water from a container to irrigate.
- Remove contact lenses with a lens removal suction bulb. Gently place bulb cup end against the contact lens; then pull the bulb away from the eye in a straight line. Be sure not to touch the cornea with the suction bulb, since permanent damage may be caused. If you encounter difficulty, slide the lens onto the sclera and continue irrigation. Save each lens in a separate, labeled sterile container filled with sterile saline solution.
- In adults, if globe and lid are intact and without edema, an eye irrigation lens (Morgan Therapeutic Lens) may be used. Flush each eye continuously during transport with a minimum of 1000 ml of normal saline. Do not force lens; if unable to insert easily, do not use.

Lens insertion

- Have advanced personnel instill topical anesthetic.
- Attach IV tubing to lens.
- Start irrigation fluid flow.
- Have patient look down, insert lens under upper lid.
- Have patient look up, retract lower lid, and gently lower lens into place.

Lens removal

- Have patient look up, retract lower lid below the inferior border of the lens, and hold that position.
- Have patient look down, retract the upper lid, and the lens will be extruded.
- Use caution not to flush chemical into other eye. Flush from the medial canthus of the eye to the lateral aspect of the globe.

ALTERNATIVE EYE IRRIGATION METHODS

- If unable to use lens, irrigate each eye continuously during transport with a minimum of 1000 ml of normal saline using large-bore IV tubing.
- Use caution not to flush chemical into other eye. Flush from the medial canthus of the eye to the lateral aspect of the globe.
- A nasal cannula taped to the bridge of the nose may be used for simultaneous hands-free irrigation of both eyes. IV tubing from a 1000-ml bag of normal saline is connected to the cannula tubing to deliver the irrigation fluid.

EYE IRRIGATION IN CHILDREN

- In children, irrigate each eye continuously during transport with a minimum of 1000 ml of normal saline using large-bore IV tubing.
- Use caution not to flush chemical into other eye. Flush from the medial canthus of the eye to the lateral aspect of the globe.

ADVANCED TREATMENT

- Check for allergies to "caine" drugs. If no contraindications, administer 1 to 2 drops of proparacaine hydrochloride in each eye to facilitate the use of irrigation lens.

SPECIAL CONSIDERATIONS

- Advise patient not to rub eyes.
- Do not force irrigation lens; if difficulty is encountered inserting lenses, do not use them.
- Remember, rapid ocular decontamination is essential.
- Continue to irrigate during transport.
- Conjunctival sac pH is usually measured at 10-minute intervals during irrigation. The target range for conjunctival sac pH is between 7 and 8. With effective irrigation, most pH paper shows approximately a pH of 8 when touched to the area of the lower conjunctival fornix. In cases of concentrated acid or alkali burns, eye irrigation may need to be continued for up to 2 hours or more in an attempt to normalize the pH of the anterior chamber.
- Obtain ophthalmological consultation as required.

Frostbite

MECHANISM OF INJURY

Frostbite can be caused by contact with leaking compressed gas or cryogenic cylinders.

SIGNS AND SYMPTOMS

Superficial frostbite to the skin presents with a red color followed by gray, white, or mottled coloring. Patients report stinging, burning, or paresthesia. The affected area is stiff to the touch, but underlying tissues remain soft.

Deep frostbite presents with a white, yellow-white, or mottled, bluish-white colored skin that is hard, cold, and insensitive to the touch.

BASIC TREATMENT

- Ensure that patient is decontaminated. Remove all clothing, shoes, and jewelry. Wash the patient with soap and water.
- Ensure an open airway and support respirations if necessary.
- Administer oxygen at 10 to15 L/min by nonrebreather mask.
- Handle the affected area gently and protect it from friction and pressure.
- For superficial frostbite, rewarm with body heat. Do not use dry or radiant heat.
- For deep frostbite or frozen skin areas with extensive transport times to the hospital, warm the affected area in a water bath at a temperature of 37.8° to 40.6° C/100° to 105° F. Monitor the temperature of the bath and ensure that it remains constant. Keep area immersed until it is completely flushed in color, is warm to the touch, blanches with tactile pressure, and stays flushed when removed from the bath. Do not use dry or radiant heat.
- Prolonged rewarming may be necessary, and the procedure may be very painful. Rewarming may be best accomplished in the hospital setting, unless transport times are long.
- Check neuro/vascular status before and after warming.
- Place sterile cotton between affected digits.
- Apply soft, sterile dressings lightly over affected parts.
- Maintain body temperature with blankets. Do not apply external heat.
- Assess and treat any other injuries.

ADVANCED TREATMENT

- Consider administering morphine sulfate as an analgesic if no respiratory distress or other trauma is present (Direct physician order only. Refer to morphine sulfate protocol in Section Four).

SPECIAL CONSIDERATIONS

- Do not remove clothes that are frozen to the area until after the area is warmed.
- Do not allow area to refreeze.
- Do not apply antibiotic or anesthetic ointments.
- Do not rupture blisters.

Heat Stress

MECHANISM OF INJURY

The ability of the body to regulate heat may be impaired by chemical exposure and by wearing personnel protective equipment. This overloads the individual's thermal response mechanism and at the same time increases an individual's heat production by adding bulk and weight, which increases the work necessary to perform required activities. Certain chemical exposures (pentachlorophenol, dinitrophenol, 2,4-D/2,4,5-T, and sodium azide) may also cause an increased risk of heat exposure.

HEAT STRESS FACTORS

- Environmental temperature
- Radiant heat
- Humidity
- Workload
- Personal protective equipment

PREDISPOSING FACTORS

- Lack of physical fitness
- Lack of heat acclimatization
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease

PERSONAL PROTECTIVE EQUIPMENT

- Adds weight and bulk
- Impairs the body's normal heat exchange mechanisms (evaporation, convection, radiation)
- Increases energy expenditure

TYPES OF HEAT STRESS

HEAT FATIGUE

- Common effect of prolonged heat exposure
- Loss of coordination and alertness
- Heat rash, edema, and fatigue

HEAT CRAMPS

- Physically fit individual but poorly acclimatized
- Occurs during or after work
- Affects most major muscle groups
- Cause unknown

HEAT SYNCOPE

- Self-limited in nature
- Probably vasovagal in origin
- Increased risk with conditions causing dehydration

HEAT EXHAUSTION

- Ill-defined precursor of heatstroke
- Caused by excessive loss of fluid and/ or electrolytes through perspiration
- Patient shows postural vital sign changes
- Nausea and vomiting
- Confusion
- Elevated core temperature up to 40° C/104° F
- SUSPECT HEAT STROKE

HEAT STROKE

- The body's heat regulatory process fails, and the sweating mechanism stops. Heat stroke is a life-threatening condition.
- Decreased level of consciousness, seizures, and coma. Mental status abnormalities are the most important indicators of heat stroke.
- Tachycardia
- Hyperventilation
- Usually skin is dry, but in the initial stages of occupational heat stroke the skin may be wet.
- Temperature core elevated greater than 40° C/104° F
- T-wave ECG changes may be seen.

TREATMENT (BASIC AND ADVANCED AS APPROPRIATE)

- Heat fatigue
  - Rest
  - Cool climate
  - Fluid replacement
  - Transport to hospital if necessary
- Heat cramps
  - Rest
  - Cool climate
  - Oral fluid replacement
  - Do not use hot packs
  - Do not massage the cramping area
  - Transport to hospital if necessary
- Heat syncope
  - ABCs
  - Place patient in supine position
  - Raise legs 6 to 8 inches
  - Rule out other causes
  - Oral fluid replacement if no airway compromise
  - Assess for toxic exposure or other causes
  - Transport to hospital as necessary
- Heat exhaustion
  - ABCs
  - Administer oxygen (10 to 15 L/min) by nonrebreather mask
  - Remove from exposure
  - Rapid cooling
  - Cardiac monitoring. Treat arrhythmias if necessary (refer to cardiac protocol in this section)

IV fluids normal saline or lactated Ringer's titrated to maintain adequate BP
Assess for toxic exposure or other causes
Transport to appropriate medical facility

- Heat stroke
  - ABCs; intubate if necessary
  - Administer oxygen (10 to 15 L/min) by nonrebreather mask
  - IV fluids, normal saline or lactated Ringer's, titrated to maintain adequate BP
  - Cardiac monitoring. Treat arrhythmias if necessary (refer to cardiac protocol in this section)
  - Rapid cooling
    - Ice packs in areas where blood vessels are close to skin surface
    - Water mist, to allow for evaporation on skin and maximum cooling effect
    - Large fans
    - Cold water–soaked sheets or towels placed over body
    - Cold water poured over patient (not as effective as water mist unless in high-humidity atmospheres)
    - Submersion in cold water (very difficult to care for patient)
  - Treat hypotension (refer to shock protocol in this section)
  - Treat seizures (refer to seizure protocol in this section)
  - To avoid overcooling and hypothermia, slow or modify cooling measures when temperature reaches 37 8 to 38.9° C/100 to 102° F.
  - Assess for toxic exposure or other causes
  - Rapid transport to appropriate medical facility

SPECIAL CONSIDERATIONS

- Condition may be aggravated by certain drugs (atropine, belladonna, antihistamines, diuretics, thyroid hormone, acetylsalicylic acid).
- Exposure to compounds such as sodium azide, pentachlorophenol, dinitrophenols, 2,4-D and 2,4,5-T may cause disturbances in body temperature regulation and exacerbate heat stress conditions.
- Exposures above 39° C/102.2° F for extended periods of time in the first trimester of pregnancy may increase the risk of birth defects.
- Refer to Hazardous materials team medical support protocol in Section Five for prevention and monitoring guidelines.

Hypothermia

MECHANISM OF INJURY

Body core temperature below 35° C/95° F caused by prolonged exposure to cold environments or abnormal thermoregulation:

Core Temperature	Symptoms
32 to 35° C/89.6° to 95° F	Mild symptoms
32° C/89.6° F	Moderate symptoms
30° C/86° F or below	Profound hypothermia; high mortality rate

Patients may develop hypothermia while undergoing decontamination procedures in cold environments. Removing protective equipment in cool environments may lead to rapid cooling as a result of evaporation from moist skin.

SIGNS AND SYMPTOMS

Cardiovascular—Bradycardia, arrhythmias (AV block, nodal tachycardia, atrial and ventricular fibrillation, increased QT interval, PVCs, and Osborne J waves), and hypotension.

Respiratory—Decreased rate and depth.

CNS—Decreased level of consciousness, confusion, lethargy, stupor, and withdrawn or combative behavior. Paresthesias and pain in the extremities. Shivering may occur in an attempt to raise body temperature.

Skin—Pale and cool.

Other—Shivering stops at a core temperature of 30° C/86° F. Mild hypothermia may present with an uncoordinated, staggering gait. Severe hypothermia may present with stiffness, rigor, and an inability to walk.

GENERAL TREATMENT

- Ensure adequate decontamination.
- Ensure an open airway and assist ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Remove wet clothing and protect against wind chill.
- Place patient in horizontal position.
- Cover with warm blankets.
- Avoid rough movement and excessive activity
- Monitor cardiac rhythm if equipped and qualified.
- Monitor core temperature.

SPECIFIC TREATMENT (AS QUALIFIED)

If pulse and breathing are present and core temperature is 34 to 36° C/93.2 to 96.8° F:

- Continue passive rewarming (dry clothing and blankets).
- Perform active external rewarming (warm baths, hot packs, radiant heat).

If pulse and breathing are present and core temperature is 30 to 34° C/86 to 93.2° F:

- Continue passive rewarming.
- Perform active external rewarming of truncal areas only.

If pulse and breathing are present and core temperature is <30° C/86° F:

- Perform active internal rewarming.
  - Warm IV fluids at 43° C/109° F
  - Warm humidified oxygen at 42° C/108° F
  - Peritoneal lavage (KCL-free fluid)
  - Extracorporeal rewarming
  - Esophageal rewarming tubes
- Continue active internal rewarming until
  - Core temperature is >95° F/35° C.
  - Spontaneous circulation returns.
  - Resuscitation efforts cease.

If pulseless/apneic:

- Start CPR.
- Defibrillate ventricular tachycardia (VT)/ventricular fibrillation (VF) up to a total of three shocks (200 J, 300 J, 360 J).
- Intubate.
- Ventilate with warm, humidified oxygen at 42° to 46° C/108° to 115° F.
- Establish IV.
- Infuse with warm normal saline at 43° C/109° F.

If pulseless/apneic and core temperature is <30° C/86° F:

- Continue CPR.
- Withhold IV medications.
- Limit shocks for VT/VF to a maximum of three defibrillations.
- Transport to hospital.
- Follow internal active rewarming sequence detailed in previous paragraphs.

If pulseless/apneic and core temperature is >30° C/86° F:

- Continue CPR.
- Give IV medications as indicated but at longer than standard intervals.
- Repeat defibrillation for VT/VF, which may occur as core temperature rises.
- Follow internal active rewarming sequence detailed above.

SPECIAL CONSIDERATIONS

- Rough handling, including intubation, may precipitate ventricular fibrillation.
- All active internal and active external rewarming procedures are better carried out in-hospital. This includes the use of warmed IV fluids and warm, humidified oxygen ventilation.
- Decontamination efforts during weather extremes should be carried out with warm water or in heated areas whenever possible. This minimizes the risk of hypothermia. Warm blankets should be available to cover patients immediately after decontamination.
- Tympanic membrane or rectal temperatures should be used to guide treatment.

Patient Evaluation

ROUTES OF EXPOSURE
- Inhalation
- Skin absorption
- Skin and eye contact
- Ingestion
- Injection

POTENTIAL CHEMICAL HAZARDS
- Flammables
- Corrosives
- Poisons
- Sensitizers (allergens)

POTENTIAL PHYSICAL HAZARDS
- Fire
- Heat
- Cold
- Mechanical trauma
- Explosion

EVENT HISTORY
- Nature of accident
- Substance(s) involved
- Route of exposure
- Duration of exposure
- Number of patients
- Associated trauma
- Past medical history
- Allergies and medications
- Exam findings and vital signs
- Initial signs and symptoms
- Signs and symptoms at initial EMS evaluation
- Treatment administered
- Signs and symptoms now
- Compatibility of signs and symptoms with poisoning and exposure pattern

PATIENT EXAMINATION
- Primary examination (ABCDE)
  - Airway
  - Breathing
  - Circulation/C-spine
  - Decontamination needs
  - Evaluate for systemic toxicity
  - Skin color and condition
- Secondary examination
  - Vital signs
  - Confirm history of exposure

- Take pertinent medical history
  - Current medications
  - Medication for allergies
  - Serious illnesses/operations
  - Previous exposures
- Complete physical examination with special attention to
  - Mental status/neurobehavioral assessment
  - Skin and eyes
  - Airway
  - Pulmonary system
  - Cardiovascular system
  - Gastrointestinal system
  - Neurological system

POSSIBLE DIAGNOSTIC TESTS

- Complete blood count
- Reticulocyte count
- Platelet count
- Coagulation profile
- Serum electrolytes (sodium, potassium, chloride, bicarbonate)
- Determination of anion and osmolar gaps
- Blood urea nitrogen (BUN)
- Glucose
- Biochemical profile to include
  - Baseline liver survey
    - Alkaline phosphatase
    - ALT
    - AST
    - LDH
    - GGTP
    - Total bilirubin
  - Calcium
  - Creatinine
  - Phosphorus
  - Magnesium
  - Cholesterol
  - Triglycerides
- Arterial blood gases (ABGs)
  - With measured percent oxygen saturation
- Carboxyhemoglobin
- Methemoglobin
- Specific toxicology tests
  - Serum ethanol
  - Serum methanol
  - Serum ethylene glycol
  - Whole blood cyanide

- Metals
  - Arsenic (blood/urine)
  - Cadmium (blood/urine)
  - Copper (serum/blood)
  - Iron (serum)
  - Lead (blood/urine)
  - Lithium (serum)
  - Magnesium (plasma)
  - Mercury (blood/urine)
- Beryllium lymphocyte transformation test
- Total iron binding capacity (TIBC)
- Free erythrocyte protoporphyrin (FEP) or zinc protoporphyrin (ZPP)
- Plasma cholinesterase
- RBC cholinesterase

- Other toxilogical tests as indicated by specific exposure.
- Urinalysis
- Chest radiograph
- Pulmonary function studies
- Electrocardiogram (ECG)

Pulmonary Edema

MECHANISM OF INJURY

Fluid leaking from the pulmonary capillaries into the alveoli can be caused by circulatory overload, cardiac failure, and toxic inhalations that cause either cardiac failure or direct damage to the alveolar basement membranes. Twenty percent of lung weight is fluid. With acute pulmonary edema, fluid content can reach 1000 times normal. Acute pulmonary edema usually has a rapid onset. Toxic exposures may exhibit a delayed onset of pulmonary edema from hours to days.

SIGNS AND SYMPTOMS

Cardiovascular—Increased heart rate and jugular venous distention.

Respiratory—Dyspnea, cough, Cheyne-Stokes respirations, orthopnea, moist breath sounds (rales and rhonchi), and, in severe cases, pink (blood-tinged) frothy sputum.

CNS—Anxiety, decreased level of consciousness, and coma.

Other—The cause, either cardiac or direct lung damage, must be determined.

BASIC TREATMENT

- Ensure an open airway; suction if necessary.
- Support respirations if necessary
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Position patient in a sitting position to increase gas exchange.
- Place arms and legs in a dependent position if possible.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control.
- Consider positive-pressure ventilation.
- Monitor cardiac rhythm and treat arrhythmias if necessary.
- Start an IV of 5% dextrose in water (D_5W) TKO.
- Administer furosemide (Lasix) if patient is not hypotensive. (By direct physician order. Refer to furosemide protocol in Section Four).
- Consider the use of metaproterenol sulfate (Alupent) to decrease reversible bronchospasm if wheezes are present. (By direct physician order. Refer to metaproterenol sulfate protocol in Section Four.)

If pulmonary edema is due to cardiac (pump) failure:

- Administer morphine sulfate. (By direct physician order. Refer to morphine sulfate protocol in Section Four.)
- Administer aminophylline. (By direct physician order. Refer to aminophylline protocol in Section Four.)
- Refer to ACLS Hypotension/Shock/Acute Pulmonary Edema Algorithm in the cardiac protocol section for further information.

Seizures

MECHANISM OF INJURY

Many metabolic disturbances can result from toxic exposures such as hypocapnia, cerebral anoxia, water intoxication, and hypoglycemia. Seizures can result from any of these abnormalities. Certain compounds such as strychnine, picrotoxin, pentylenetetrazol, camphor, DDT, chlorinated insecticides, parathion and other organophosphates, and fluroacetates may cause seizures.

SIGNS AND SYMPTOMS

CNS—Focal, grand mal seizures, and/or status epilepticus.

Other—Increased temperature, fractures, dislocations, trauma to the tongue, and incontinence of urine and stool.

BASIC TREATMENT

- Ensure an open airway and support ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Do not force anything between the teeth.
- Protect patient from injury. Do not restrain.
- Reassess patient following seizure.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control in the unconscious patients or patients with status epilepticus.
- Monitor cardiac rhythm and treat arrhythmias if necessary.
- Start an IV of lactated Ringer's or normal saline TKO and draw blood for later laboratory analysis.
- Monitor for signs of hypoglycemia (decreased level of consciousness, tachycardia, pallor, dilated pupils, and diaphoresis).
- If signs of hypoglycemia and/or low blood glucose (<50 mg/dl) are present, administer 50% dextrose if necessary. Draw blood sample for glucose determination before administration. (Refer to 50% dextrose protocol in Section Four.)
- If patient is actively convulsing, administer diazepam (Valium) or lorazepam (Ativan). (Refer to diazepam and lorazepam protocol in Section Four.)

SPECIAL CONSIDERATIONS

- Diazepam and lorazepam may depress respiratory drive; be prepared to assist respirations.
- Reduce external stimuli as much as possible.

Shock

HYPOVOLEMIC

MECHANISM OF INJURY

Chemical exposure can cause increased permeability of the blood vessel walls, with leakage of plasma (water) across cell membranes out of the vascular system, causing hypovolemia. Trauma conditions causing hemorrhage may also occur.

SIGNS AND SYMPTOMS

Cardiovascular—Usually pulse rate is >120 beats/min and weak (bradycardia or normal rate may be observed). BP <90 torr systolic with jugular venous pressure decreased. Positive orthostatic changes are present (pulse rate increase of 20 or more, or a blood pressure decrease of 20 torr or more, or a combination of 20 or more when the patient is moved from supine to standing position).

Respiratory—Increased rate with shallow respirations.

CNS—Anxiety, restlessness, confusion, decreased level of consciousness, and coma.

Skin—Pale, diaphoretic, cool or, in cases of dehydration, warm and dry.

BASIC TREATMENT

- Ensure an open airway and support ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Control any external bleeding.
- Elevate legs 10 to 12 inches.
- Splint fractures.
- Maintain body temperature.
- Monitor vital signs every 5 minutes.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control.
- Start an IV of lactated Ringer's or normal saline. Administer a fluid bolus of 250 to 500 ml in the adult patient—20 ml/kg in the pediatric patient (may be repeated up to three times). Titrate IV to maintain an adequate blood pressure. If no response, consider the use of sympathomimetics (direct physician order only).

SPECIAL CONSIDERATIONS

- The use of the pneumatic antishock garment is controversial but may be useful in certain circumstances. Consult your local medical advisor.
- Hypotension is a late sign. Be prepared to institute treatment before the blood pressure falls.
- After IV fluids are started during initial resuscitation efforts, watch for signs of fluid overload and cerebral and/or pulmonary edema.
- The elderly and patients with chronic hypertension may be hypovolemic, with vital signs that appear normal.
- Look for cardiac signs with traumatic shock: cardiac tamponade and tension pneumothorax.
- Rapid transport to an appropriate treatment center is essential; do not waste time on scene.
- Refer to ACLS Hypotension/Shock/Acute Pulmonary Edema Algorithm in the cardiac protocol in this section for further information.

CARDIOGENIC

MECHANISM OF INJURY

Chemical agents may impair the cardiovascular system by reducing the circulation by direct cardiotoxicity. Many types of cardiac problems, including electrical conduction deficits and loss of contractility, may be seen.

SIGNS AND SYMPTOMS

Cardiovascular—Chest pain or a heavy pressure sensation in the chest. BP <90 torr systolic; pulse rate normal, fast, or slow and possibly irregular. Jugular venous pressure is increased, but may be normal in the initial stages.

Respiratory—Increased rate with shallow respirations. Signs of pulmonary edema.

CNS—Anxiety, restlessness, confusion, decreased level of consciousness, and coma.

Skin—Cyanotic, cool, and diaphoretic.

BASIC TREATMENT

- Ensure an open airway and support ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Ensure complete rest and position of comfort.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control.
- Monitor cardiac rhythm and treat arrhythmias if necessary.
- Start an IV of D_5W TKO.
- Administer norepinephrine or dopamine (Intropin). Titrate to a systolic blood pressure of 90 to 100 torr, by direct physician order (refer to specific drug protocols in Section Four).
- Treat pulmonary edema symptoms if necessary.
- Use a cautious fluid challenge of 250 ml of lactated Ringer's or normal saline if signs of hypovolemia are present, by direct physician order only.

SPECIAL CONSIDERATIONS

- Rapid transport is essential.
- Refer to ACLS Hypotension/Shock/Acute Pulmonary Edema algorithm in the cardiac protocol in this section for further information.

ANAPHYLACTIC

MECHANISM OF INJURY

In severe allergic reactions, the body reacts to a foreign substance by releasing histamine and other chemical mediators of anaphylaxis. These may cause bronchial spasm and dilation of peripheral blood vessels and alter the permeability of the cell membranes, allowing fluid to leak from the vascular space into the interstitial spaces.

SIGNS AND SYMPTOMS

Cardiovascular—Increased pulse rate with a BP <90 torr systolic. A tight feeling may be present in the chest.

Respiratory—Cough and stridor, possibly indicating an upper airway obstruction. Dyspnea and diffuse wheezing.

CNS—Headache, anxiety, restlessness, decreased level of consciousness, and coma.

Skin—Facial edema and a flushed appearance with rash, redness, and itching.

BASIC TREATMENT

- Ensure an open airway and support ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control. Intubation may be necessary at the first indication of upper airway obstruction.
- Monitor cardiac rhythm and treat arrhythmias if necessary.
- Start an IV of lactated Ringer's or normal saline to keep open (TKO).
- Administer epinephrine SQ or, if symptoms are severe, IV push, by direct physician order or standing order protocol (refer to epinephrine protocol in Section Four).
- Consider the use of metaproterenol sulfate (Alupent) to decrease reversible bronchospasm. Adult Dosage: one unit-dose vial of 0.6% via nebulizer (refer to metaproterenol sulfate protocol in Section Four), by direct physician order.

SPECIAL CONSIDERATIONS

- Rapid transport is essential.
- Use epinephrine with caution in children and elderly patients.
- Refer to ACLS Hypotension/Shock/Acute Pulmonary Edema algorithm in the cardiac protocol in this section for further information.

VASOGENIC

MECHANISM OF INJURY

Chemical agents may cause a defect in the responsiveness of vascular smooth muscles to neural or hormonal stimuli or depress vasomotor center activity in the brainstem. In either case, widespread vasodilation without primary loss of volume causes hypotension.

SIGNS AND SYMPTOMS

- Cardiovascular—Usually pulse rate is >120 beats/min and weak (bradycardia or normal pulse rate possible). BP >90 torr systolic and jugular venous pressure is decreased. Positive orthostatic changes.
- Respiratory—Increased rate with shallow respirations.
- CNS—Anxiety, restlessness, confusion, decreased level of consciousness, and coma.
- Skin-Warm, dry, and flushed.

BASIC TREATMENT

- Ensure an open airway and support ventilations if necessary.
- Administer oxygen by nonrebreather mask at 10 to 15 L/min.
- Elevate legs 6 to 12 inches.

ADVANCED TREATMENT

- Consider orotracheal or nasotracheal intubation for airway control.
- Start an IV of lactated Ringer's TKO.
- Administer dopamine (Intropin) or norepinephrine (Levophed). Titrate to a systolic blood pressure of 90 to 100 mm hg (refer to specific drug protocols in Section Four), by direct physician order.

SPECIAL CONSIDERATIONS

- Rapid transport is essential.
- Refer to ACLS Hypotension/Shock/Acute Pulmonary Edema algorithm in the cardiac protocol in this section for further information.