R7DHRE Hazardous Materials Guideline: Cyanide

Region VII Disaster Health Response Ecosystem

REGION VII DISASTER HEALTH RESPONSE ECOSYSTEM (R7DHRE)

CHEMICAL SPECIALTY TEAM

Call Your Poison Center for Immediate Assistance: 1-800-222-1222

Hazardous Materials Guideline: Cyanide

This document is intended as a supplement for discussion with your local poison center or toxicologist.

1.0 BACKGROUND

1.1 Description: Cyanide is a rapidly acting cellular poison. It is found as a chemical in several forms (e.g., salts, hydrogen cyanide gas), as a metabolite of some foods, and as a metabolite of nitroprusside. **Of note, cyanide exposure can occur due to combustion of plastics, rubbers, wool, or silk such as in structure fires.**

1.2 Mechanism of Injury: Cyanide binds to cytochrome oxidase within cells, prevents cells from using oxygen, and leads to anaerobic metabolism and severe acidosis. Cyanide has the odor of bitter almonds though 30-40% of people cannot detect this odor.

1.3 Routes of Exposure: **Inhalation**, **Ingestion,** Ocular, Dermal

2.0 PROVIDER SAFETY

2.1 Personal Protective Equipment (PPE) – Decontamination Team: Personnel decontaminating patients must wear **full-body chemical-resistant clothing and respiratory protection**. Hydrogen cyanide readily penetrates most rubber and barrier fabrics, but butyl rubber provides good skin protection for a short period of time. Respiratory protection may consist of either:

2.1.1 A positive pressure air or oxygen source, such as an air-line respirator or a Self-Contained Breathing Apparatus (SCBA) or

2.1.2 A filtered air respirator (including Powered Air Purifying Respirators (PAPRs)) with filters capable of adsorbing cyanide.

2.1.3 A positive pressure air or oxygen source is preferred if there is doubt as to the identity of the chemical in question or if there may be exposure to a level of cyanide which would overwhelm the filter.

2.2 Personal Protective Equipment (PPE) – Treatment Team: Personnel treating patients who have been adequately decontaminated need no additional PPE other than **universal precautions** since there is no serious risk of secondary contamination. The **vomit from persons who have ingested cyanide is hazardous because it may off-gas cyanide gas**. Prepare treatment areas for rapid clean up in case the patient vomits.

2.3 Patient Decontamination:

2.3.1 Persons exposed to only **hydrogen cyanide gas** and have **no systemic symptoms, no skin irritation, no eye irritation, dry skin, AND dry clothes generally do not need decontamination**. These patients do not pose a significant risk of secondary contamination.

2.3.2 Persons contaminated with **liquid cyanide or cyanide powder** do **pose a risk of secondary contamination** from off-gassing of cyanide vapors and direct contact with the chemical.

2.3.3 Remove contact lenses if it can be done without additional trauma to the eye. **Irrigate eyes for a minimum of 15 minutes.** Continue irrigation until eye pH is neutral (7 to 8).

2.3.4 **Brush powders and solid material off** hair, skin, and clothing. **Remove ALL clothing and jewelry**. Double bag clothing and jewelry to prevent off-gassing.

2.3.5 Decontamination is best **accomplished by irrigation with copious amounts of water**. Wash skin and hair with plain water for a minimum of 5 minutes and then wash twice with soap & water after washing with plain water. Washing with water alone (for a longer time) is acceptable if soap is not available.

2.3.6 Watch for hypothermia (1) in children and the elderly, (2) when decontamination is done with un-heated water, or (3) during cold weather.

3.0 SIGNS & SYMPTOMS

3.1 Severity of symptoms will depend upon the dose of cyanide patients are exposed to. Severe exposures can result in the **abrupt loss of consciousness, cardiovascular collapse, and death** within minutes. The onset of symptoms from dermal exposure can be delayed for 30-60 minutes.

3.2 Cardiopulmonary: May have hypertension and tachycardia which decompensates to hypotension, bradycardia, and cardiac arrest. Shortness of breath, chest tightness, hyperpnea, and tachypnea.

3.3 Gastrointestinal: Nausea and vomiting.

3.4 Eyes: Irritation and swelling.

3.5 Neurologic: Headache. Altered mental status changes ranging from excitation to confusion to coma or death. Tetanic spasms and seizures are possible.

4.0 DIAGNOSTICS

4.1 Pulse oximetry is typically normal as oxygen extraction is impaired.

4.2 An elevated anion gap and lactic acidosis are typical. Simultaneous arterial and venous blood gas co-oximetry can be drawn - minimal to no decrease in pO2 between the two can be seen and represents poor oxygen extraction.

4.2 Consider a carboxyhemoglobin in the setting of structure fires. Consider troponins and an EKG. Other diagnostics may be indicated based on clinical judgement and the patient's presentation and level of illness.

5.0 TREATMENT

5.1 General: **Treatment emphasizes aggressive supportive care and prompt administration of antidotal therapy if indicated.** Patients may need airway management, respiratory support, cardiovascular support with IV fluids and vasopressors, treatment for severe acidemia, and treatment of seizures with benzodiazepines or other GABA agonists.

5.2 Ocular: **Irrigate eyes to a neutral pH**. Perform a thorough eye exam: test visual acuity, and perform fluorescein and slit lamp examinations. Ophthalmology consultation may be necessary. Immediately consult an ophthalmologist for patients who have corneal injuries.

5.3 Ingestion: **Do NOT induce emesis**. Activated charcoal can be considered in patients who present soon after ingestion and are conscious, able to swallow, and able to protect their airway.

5.4 ANTIDOTE: Hydroxocobalamin. Hydroxocobalamin is the preferred antidote for cyanide poisoning and indicated for signs of severe toxicity such as altered mental status, seizures, hemodynamic instability, etc. It covalently binds cyanide to form complete cyanocobalamin (Vitamin B12). Administration of hydroxocobalamin can result in transient increase in blood pressure, red urine, red skin, and red blood plasma which may interfere with measurements from a co-oximeter. Sodium thiosulfate can be given with hydroxocobalamin to hasten the metabolism of cyanide to thiocyanate.

5.4.1 Adult Dosing: 5 grams, IV, over 15 minutes

5.4.2 Pediatric Dosing: 70 mg/kg, IV, over 15 minutes

5.4.3 A second dose (5 grams for adults and 70 mg/kg for children) may be administered in severe poisonings or if there is inadequate response to the initial dosing.

5.5 ANTIDOTE: Sodium Nitrite. Sodium nitrite is administered to induce methemoglobinemia and use methemoglobin to scavenge cyanide. The target methemoglobin level is 20-30% which represents a level that an otherwise healthy individual can tolerate without significant adverse symptoms. This therapy can be problematic in patients with limited oxygen carrying hemoglobin such as those with significant carboxyhemoglobin levels.

5.5.1 Adults: 300 mg (10 mL of 3% solution), IV, over 5-10 minutes

5.5.2 Pediatrics: 6 mg/kg (0.2 mL/kg of a 3% solution), up to a maximum of 300 mg, IV, over 5-10 minutes

5.6 ANTIDOTE: Sodium Thiosulfate. Sodium thiosulfate hastens the metabolism of cyanide via the rhodanese enzyme. It can be given alone, with sodium nitrate, and with hydroxocobalamin.

5.6.1 Adults: 12.5 grams (50 mL of a 25% solution), IV, over 10-15 minutes

5.6.2 Pediatrics: 250 mg/kg (1 mL/kg of a 25% solution), up to a maximum of 12.5 grams, IV, over 10-15 minutes

Disclaimer: This guideline is intended to be an informational reference only and should not be used as a substitute for consultation with a poison center or toxicologist, and/or the clinical judgement of the bedside team.

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