R7DHRE Hazardous Materials Guideline: Arsine

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: Arsine

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

1.0 BACKGROUND

1.1 Description: Arsine is a colorless, nonirritating, highly toxic gas with a garlic-like or fishy odor. Its odor does not provide reliable warning of hazardous concentrations. By producing no immediate symptoms, persons exposed to hazardous levels of arsine may be unaware of its presence. Arsine is heavier than air and may collect in low- lying areas. Arsine is generally shipped in cylinders as a liquefied compressed gas; contact with liquid arsine may result in frostbite injury.

1.2 Mechanism of Injury: Arsine's primary effect is intravascular hemolysis, which can lead to renal failure and impaired oxygen transport. Little information exists about arsine's dermal absorption or toxic effects on the skin or eyes.

1.2.1 Arsine gas does **NOT** produce arsenic intoxication.

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

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**. 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 arsine.

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 arsine 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.

2.2.1 Persons contaminated with condensed arsine vapors of liquid arsine do pose a risk of secondary contamination from off-gassing of arsine vapors and direct contact with the chemical.

2.3 Patient Decontamination:

2.3.1 Persons exposed to only arsine gas and have no skin or eye irritation, dry skin, and dry clothes generally do not need decontamination since they do not pose a significant risk of secondary contamination.

2.3.2 If there is concern for a presence of solid (non-arsine) substances, brush any powder or solids from the skin, hair, and clothes of victims.

2.3.3 Remove ALL clothing and jewelry. Double bag clothing and jewelry to prevent off-gassing.

2.3.4 Decontamination is best accomplished by irrigation with copious amounts of water.

2.3.4.1 Wash skin and hair with plain water for a minimum of 5 minutes and then wash twice with soap after washing with plain water. Washing with water alone (for a longer period of time) is acceptable if soap is not available.

2.3.5 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).

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

3.0 SIGNS & SYMPTOMS

3.1 Severity of symptoms will depend upon the concentration of the arsine to which the person is exposed and the duration of exposure.

3.2 Inhalation: Dyspnea is an early symptom. Malaise, dizziness, nausea, headache, thirst, shivering and abdominal pain may develop within several hours. A garlic odor may be present on the breath. Delayed pulmonary edema may occur after a large exposure.

3.3 Dermal: There is little information about direct toxic effects of arsine on the skin or about arsine absorption through the skin. Exposure to liquid arsine (the compressed gas) can result in frostbite. The characteristic bronze tint of the skin found in arsine toxicity is caused by hemolysis and may be caused by hemoglobin deposits.

3.4 Ocular: There is little information about direct toxic effects of arsine on the eyes. Red staining of the conjunctiva may be an early sign of arsine poisoning.

3.5 Ingestion: This is unlikely because arsine is a gas at room temperature. However, metal arsenides are solids that can react with acidic gastric contents, releasing arsine gas in the stomach. Nausea, vomiting, and crampy abdominal pain are among the first signs of arsine poisoning; their onset varies from a few minutes to 24 hours after exposure.

3.6 Systemic: Acute intravascular hemolysis is the main systemic effect which usually develops within hours and may continue for up to 96 hours. People deficient in the enzyme glucose-6-phosphate-dehydrogenase (G6PD) are more susceptible to hemolysis. Hemoglobinuria usually occurs within hours, and the resultant acute tubular necrosis (ATN) can lead to renal failure. Methemoglobinemia can be of concern in infants up to 1 year old. EKG changes and arrhythmias associated with hyperkalemia can occur.

3.6.1 Delayed Effects: Polyneuropathy and alteration in mental status are reported to have followed arsine poisoning after a latency of 1 to 6 months.

3.6.2 Contact with the skin or eyes does not result in systemic toxicity.

4.0 DIAGNOSTICS

4.1 Arsine poisoning is a clinical diagnosis, but some diagnostic tests may be helpful in a symptomatic patient.

4.2 For a patient with shortness of breath, cyanosis, weakness, or hemodynamic abnormalities: CBC, CMP, chest x-ray, EKG.

5.0 TREATMENT

5.1 Follow standard Basic and Advanced Life Support Guidelines. There is no specific antidote for arsine.

5.1.1 Initially, patients may look relatively well. Symptoms usually occur within 30- 60 minutes with heavy exposure but can be delayed for 2-24 hours. Therefore, ALL suspected exposure victims should be evaluated and observed at a medical facility for 24 hours.

5.2 Inhalation: Maintain the patient's airway, with endotracheal intubation or cricothyroidotomy if necessary. Support oxygenation and ventilation as necessary. Use standard treatments for pulmonary edema (diuretics, PEEP, etc.) and bronchospasm (inhaled bronchodilators; consider corticosteroids).

5.3 Dermal: Treatment is the same as that of thermal burns. If *frostbite* is present, re-warm the affected area in the same manner as for environmentally-induced frostbite.

5.4 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.

5.5 Ingestion: (Ingestion of metal arsenides) Do NOT give activated charcoal or induce emesis.

5.5.1 *Consider* dilution by giving 2 to 4 ounces of milk or water orally ONLY to patients who are conscious, able to swallow, and are able to protect their airway. Endoscopic evaluation may be necessary.

5.6 Systemic:

5.6.1 Hemolysis: Ensure adequate oxygenation. Monitor hemoglobin/hematocrit; blood transfusions may be necessary if hemolysis causes severe anemia.

5.6.2 Hemolysis-induced Renal Failure: Monitor renal function and fluid balance; avoid fluid overload; monitor plasma electrolytes, particularly for hyperkalemia. Maintain good urinary output through judicious use of fluid administration and diuretics. If hemolysis develops, consider urinary alkalinization (i.e. urine pH >7.5). Consider hemodialysis if renal failure develops.

5.6.3 Delayed Effects: Because of the possibility of delayed onset of polyneuropathy and alteration in mental status, patients should be evaluated periodically by their physician for several months.

5.6.4 There are no antidotes for arsine poisoning. Do not administer arsenic chelating drugs; they are not effective antidotes for arsine poisoning and are not recommended.

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.

Author(s): Dan McCabe, MD and the R7DHRE Chemical Specialty Team