

Poison Facts:

Medium Chemicals: Nitrogen Dioxide

Properties of the Chemical

Nitrogen dioxide is a relatively water-insoluble gas that is reddish-brown in color. It has an irritating odor and is deadly.

Uses of the Chemical

Nitrogen dioxide is encountered in grain storage silos and welding operations, as well as in the combustion of fuels or nitrogen-containing materials, the production and use of nitrate explosives and through the handling of rocket fuel oxidizers. It is an intermediate in nitric and sulfuric acid production. It has been used to bleach flour.

Absorption, Distribution, Metabolism and Excretion (ADME)

Because nitrogen dioxide is relatively insoluble in water, there is little absorption by, and irritation of, the mucous membranes of the eyes, nose and throat. Therefore, people who inhale even high concentrations may not be aware of their exposure. This lack of water solubility allows nitrogen dioxide to penetrate well into the pulmonary parenchyma, where it causes oxidant injury to terminal bronchioles and to both endothelial and epithelial layers of the alveolar-capillary membrane. Nitrogen dioxide reacts with water in the respiratory tract to form nitric acid. The nitrates and nitrites formed from the dissociation of nitric acid cause extensive local and systemic tissue damage. Death may result due to the blockage of gas exchange in the lungs.

Clinical Effects of Acute Exposure

- **Ocular exposures:** This type of exposure may cause redness, pain and severe deep burns due to the reaction of nitrogen dioxide and water to form nitric acid.
- **Dermal exposures:** Irritation, redness, pain and burns may follow dermal exposure.
- **Inhalation exposures:** Nitrogen dioxide is one of the most insidious gases. Initially, inflammation of the lungs may cause only slight pain or go unnoticed. The onset of symptoms may be delayed for up to 30 hours. Symptoms may include cough, dyspnea, fever, mucoid frothy sputum, decreased pulmonary function, bronchitis, chest pain, pulmonary edema, cyanosis, tachypnea and tachycardia. Chest radiographs may be normal on clinical presentation but progress to show evidence of pulmonary edema. Patients adequately supported through the initial phase may recover and go on to develop a late phase of illness 2 to 6 weeks later. This phase is characterized by progressive dyspnea, fever and patchy infiltrates. Inhalation of nitrogen dioxide may also lead to the generation of methemoglobinemia.
- **Ingestion exposures:** Because nitrogen dioxide is a gas under ambient conditions, oral exposure normally does not occur.

In-Field Treatment Prior to Arrival at a Health Care Facility

- **Ocular exposures:** Flush exposed eyes with running water for 15 minutes.
- **Dermal exposures:** Rinse with plenty of water, then remove contaminated clothing and rinse again.
- **Inhalation exposures:** Move the patient from the toxic environment to fresh air at once. Monitor for respiratory distress. If breathing is difficult, give oxygen.
- **Ingestion exposures:** Oral exposure normally does not occur.

Special note to first responders:

- Wear a positive-pressure Self-Contained Breathing Apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer. It may provide little or no thermal protection.

Treatment of Exposures in a Health Care Facility

- **Ocular exposures:** This substance is a strong eye irritant due to the formation of nitric acid, which can permanently alter proteins. This reaction is relatively slow, permanent injury may be prevented by IMMEDIATE DECONTAMINATION. Remove contact lenses, and irrigate eyes with copious amounts of room temperature water or saline for at least 15 minutes.
- **Dermal exposures:** Remove contaminated clothing, and wash the exposed area extremely thoroughly with soap and water.
- **Inhalation exposures:** Monitor the patient for respiratory distress. If cough or difficulty breathing develops, evaluate for respiratory tract irritation, bronchitis or pneumonitis. Treat bronchospasm with inhaled beta2 agonist and oral or parenteral corticosteroids. Treatment of pulmonary edema should be directed toward the reversal of ventilatory failure by using oxygen in assisting ventilation. A steroid may be beneficial in decreasing the amount of inflammation. Maintain oxygenation and ventilation, and evaluate with arterial blood gases or pulse oximetry monitoring. Methemoglobinemia should be treated with methylene blue. Administer 1 to 2 mg/kg of 1 percent methylene blue IV in symptomatic patients.
- **Ingestion exposures:** Oral exposure is not common. Follow recommendations under “inhalation exposures” when appropriate.

For more poison prevention and first aid information, call the

Poison Control Center

Serving the Residents of Kansas

Toll-free Hotline

1-800-222-1222

THE UNIVERSITY OF KANSAS HOSPITAL

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