CBRN Hazards: Cyanide Agents

Hydroxocobalamin is the preferred antidote.

Agent Overview

Cyanide agents are rapidly acting systemic asphyxiants that interfere with oxygen transport and/or utilization, even when oxygen delivery to tissues is intact.

- **Weaponized forms:**
  - **Hydrogen cyanide (HCN):** colourless gas or volatile liquid with faint bitter almond odour.
  - **Cyanogen chloride (CNCl):** vapour causes mucous membrane and pulmonary irritation in addition to systemic toxicity.
  - **Cyanide salts (NaCN, KCN):** ingestion or skin contact with concentrated solutions causes systemic toxicity, typically with a delay of 15–30 minutes.
- **Smoke inhalation:** Combustion of many common materials releases hydrogen cyanide. Cyanide toxicity should be considered in any unconscious or severely ill victim of an enclosed-space fire.

Exposure and Onset

- **Routes of exposure:**
  - **Inhalation:** onset within seconds to minutes.
  - **Ingestion:** cyanide salts; typical onset 15–30 minutes.
  - **Dermal/ocular:** concentrated liquid or dissolved salts; significant absorption possible through compromised skin with delayed onset of toxicity.
- **Onset and duration:** Onset and severity depend on route and dose. High-concentration inhalation causes loss of consciousness (LOC) within seconds and cardiac arrest in minutes. Lower concentrations and ingested salts progress gradually to altered LOC, seizures and cardiovascular collapse. Cyanogen chloride exposures produce mucous membrane and respiratory irritation before systemic effects.

Clinical Features

- **Neurological**: Anxiety, confusion, delirium, seizures, coma.
- **Cardiovascular**: Tachycardia; in severe poisoning: hypotension, arrhythmia, cardiovascular collapse.
- **Respiratory/Other**: Tachypnea early, progressing to bradypnea and apnea in severe poisoning; nausea, vomiting and diaphoresis. Cyanosis may be absent; cherry-red skin is an unreliable and uncommon finding.
- **Serious complications:** Seizures; cardiovascular collapse and cardiac arrest
- **Smoke inhalation**: Suspect cyanide poisoning in fire victims with altered consciousness or cardiovascular instability disproportionate to their airway injury or carboxyhemoglobin level.

Diagnostic Tests

- Diagnosis is clinical. Blood cyanide concentrations are unavailable emergently, with no role in clinical decision-making.
- **VBG with lactate:** elevated lactate is the most useful bedside marker. See Antidote section below.
- **Co-oximetry:** carboxyhemoglobin and methemoglobin levels to identify co-exposures; conventional pulse oximetry is unreliable.
- **ECG:** baseline; monitor for arrhythmia and ST changes.

Treatment and Decontamination

- **Contact the Ontario Poison Centre for case-specific clinical guidance: 1-800-268-9017.**

Staff protection

- Follow institutional CBRN/HazMat PPE protocols before any patient contact.
- **For concentrated cyanide salt solution or powder, minimum gloves, gown, eye protection, and surgical mask until decontamination complete. For HCN gas exposure, off-gassing is not a significant hazard once patient is removed from source**. For decontaminated patients, use universal precautions. Where possible, treat in a well-ventilated area.

Patient decontamination (perform first)

- Remove all clothing and footwear immediately; double bag and seal. **HCN gas exposure does not require skin decontamination beyond clothing removal. For liquid or solid cyanide salt exposure**, remove contact lenses and irrigate eyes with copious water or saline for 15–20 minutes. Gently wash skin with copious water and soap.
- Asymptomatic/mildly symptomatic patients do not worsen once HCN gas exposure is terminated and will not develop delayed-onset symptoms. Dermal or ingestion exposures may involve ongoing absorption and delayed toxicity.

Resuscitation

- 100% oxygen; airway and hemodynamic management as indicated, including metabolic acidosis; treat seizures with benzodiazepines.

Antidote

- **Hydroxocobalamin (Cyanokit®)**: Give empirically in any patient with known or suspected cyanide exposure with altered consciousness, seizures, cardiovascular instability, or severe metabolic acidosis with elevated lactates (≥ 8–10 mmol/L). Do not wait for confirmatory results.
  - **Adults**: 5 g IV over 15 mins; may repeat up to 15 g total in severe or refractory cases;
  - **Children**: 70 mg/kg IV over 15 mins; may repeat after 15 min in severe or refractory cases.
- **Sodium thiosulfate**: Adjunct to hydroxocobalamin in severe cases; alternative if kit unavailable. Administer using separate IV line from hydroxocobalamin.
  - **Adults**: 12.5 g (50 mL of 25% solution) IV slowly;
  - **Children**: 0.25 g/kg (max 12.5 g) IV slowly.

This fact sheet is part of a just-in-time resource series for first receivers and was co-authored by Public Health Ontario (PHO) and Ontario Poison Centre (OPC). Contact OPC for 24/7 clinical guidance: 1-800-268-9017. See the CBRN Reference List for the full list of references used in these fact sheets.

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