Cyanide Poisoning

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Risk

- Potent rapid-onset toxin, especially with inhalation of HCN (volatile liquid).
- May be absorbed through mucous membranes; CN ingestion results in slower onset.
- Diffuses rapidly through body with high intracellular fixation to cytochrome aa_3 in cellular mitochondria to paralyze aerobic metabolism.

Perioperative Risks

- Main target organs: CNS and heart.
- Animal experiments: Apnea precedes cardiac collapse.

Worry About

- If CN toxicity resulted from fire or smoke exposure, consider also CO and other toxins.
- One third of pts with CO toxicity exposed to domestic fires also have increased CN.
- Be alert for CN poisoning in donors for organ transplantation.

Overview

- Major route of CN detoxification: Conversion to thiocyanate, which requires sulfane sulfur donor (e.g., thiosulfate) and enzyme (e.g., rhodanese); without renal excretion, increase in thiocyanate can cause CNS abnormalities.
- Minor route: Hydroxocobalamin (one form of vitamin B_{12}) chelates CN to form cyanocobalamin.
- metHb ferric ion has high affinity for CN.

Etiology

- Combustion product of natural and synthetic polymers
- Industrial chemistry (e.g., metals and plastics preparation)
- Plants: May contain cyanogenic glycosides
- Na nitroprusside: Overtreatment (>0.5 mg/kg/h within 24 h)
- Abuse (e.g., suicide, Chicago CN-laced-Tylenol murders [1982], terrorism, chemical warfare)

Usual Treatment

- Rescue victim from exposure.
- Intubation and ventilation with 100% O_2 (hyperbaric O_2, effective experimentally, is not practical).
- Gastric decontamination (if necessary).
- Weigh risks and/or benefits of drug therapy, since the half-life of CN is short (about 1 hr).
- Sodium thiosulfate (adult: about 150 mg/kg IV over 10 min) (minimal side effects, but thiocyanate requires renal excretion or hemodialysis); usually administered with sodium nitrite.
- Hydroxocobalamin (adult: 5–10 g IV over 20 min); safe and rapid.
- Methemoglobinemia induction (metHb, 30%) with sodium nitrite (adult: 300 mg IV over 10 min); slow and unpredictable; can be hazardous in presence of carboxyhemoglobin (from CO toxicity) because neither metHb nor COHb carries O_2; can be fatal in G6PD deficiency.
- Dicobalt EDTA (adult: 300 mg IV) followed by glucose infusion; potent and rapid but unsafe (especially due to arrhythmias, hypotension, and allergic reactions).

Assessment Points

System	Effect	Assessment by Hx	PE	Test
HEENT	Decreased CNS depression leading to decreased airway maintenance/protection	Concomitant smoke inhalation injury	Perioral burns Airway edema	Laryngoscopy/bronchoscopy
CV	Stimulation at low CN concentration Depression at high CN concentration	Htn, tachycardia Hypotension, bradycardia	Increased cardiac output Decreased cardiac output, arrhythmias	ECG: Arrhythmias, especially decreased conduction, VTach, VFIB
RESP	Aerobic cellular respiration paralyzed			Increased blood PvO_2 and increased SvO_2 decreased VO_2, decreased VCO_2, decreased $PETCO_2$
	Thermal/toxic airway and parenchymal injury	Concomitant smoke inhalation injury	Bronchoconstriction and pulm edema	CXR Bronchoscopy
METAB	Cellular aerobic metabolism disabled	Combination of increased SvO_2 and lactic acidosis suggests CN toxicity	Blood CN level toxic above 0.2 mg/L	Lactic metabolic acidosis Whole blood CN levels (not available in all labs)
CNS	Stimulation at low CN concentration	Increased inhalatory CN intake Anxiety, dyspnea, headache Auditory/visual disturbances	Increased respiratory rate Confusion	
	Depression at high CN concentration		Apnea, convulsions, coma; Chronic sequelae possible	Funduscopy: Red retinal veins (increased SvO_2)

Key Reference: Breen PH, Isserles SA, Tabac E, et al.: Protective effect of stroma-free metHb during cyanide poisoning in dogs, *Anesthesiology* 85(3):558–564, 1996.

Perioperative Implications

Preoperative Preparation

- Continuous 100% O_2

Monitoring

- SpO_2 unreliable in presence of metHb (or COHb if coexistent CO poisoning)
- SvO_2 or PvO_2
- $PETCO_2$
- Measurement of VO_2 and VCO_2 helpful.

Airway

- Protect and maintain airway.

Induction

- Avoid CV depressant agents.

Maintenance

- 100% O_2 (no N_2O)

Extubation

- Ensure that CNS status permits natural airway maintenance and protection.

Adjuvants

- Consider treatment for concomitant CO poisoning (see Carbon Monoxide Poisoning).

Postoperative Period

- Maintain 100% O_2 breathing.

Anticipated Problems/Concerns

- Heart and brain are target organs.
- Prompt CPR (ventilation with O_2) determines outcome.
- Follow CNS function.
- Seek concomitant smoke inhalation injury and CO toxicity.

Cystic Fibrosis

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Risk

- Prevalence ranges from 1:2500 births in white population to 1:17,000 in African Americans; prevalence growing faster than incidence as median survival is increasing.
- For pts with CF, 50% of are older than 18 y of age; 30,000 affected in USA; 3000 affected in Canada; 20,000 affected in Europe.
- In white population, 2–5% are carriers,

Perioperative Risks

- Pulmonary:
  - Hypoxia and hypercarbia
  - V/Q mismatching