Cyanide Exposure

Aliases

Cyanide, hydrogen cyanide, blood agent

Patient Care Goals

1. Remove the patient from the toxic environment.
2. Assure adequate ventilation, oxygenation and correction of hypoperfusion.

Patient Presentation

Cyanide is a colorless, "bitter almond smell" (genetically only 40% of population can smell) gas or white crystal which binds to the ferric ion in cells, blocking the enzyme cytochrome oxidase, thus preventing the use of oxygen by the cell's mitochondria, leading to cellular hypoxia.

Inclusion Criteria

1. Depending on its form, cyanide can enter the body through inhalation, ingestion, or absorption through the skin. Cyanide should be suspected in occupational or other smoke exposures (e.g. firefighting), industrial accidents, natural catastrophes, suicide and murder attempts, chemical warfare and terrorism (whenever there are multiple casualties of an unclear etiology). Non-specific and early signs of cyanide exposure (inhalation, ingestion, or absorption) include the following signs and symptoms: anxiety, vertigo, weakness, headache, tachypnea, nausea, dyspnea, vomiting, and tachycardia.
2. High concentrations of cyanide will produce:
    a. Markedly altered level of consciousness, including rapid collapse.
    b. Seizures.
    c. Respiratory depression or respiratory arrest.
    d. Cardiac dysrhythmias (other than sinus tachycardia).
3. The rapidity of onset is related to the severity of exposure (inhalation or ingestion) and may be dramatic with immediate effects that include early hypertension with subsequent hypotension, sudden cardiovascular collapse, seizure or coma, and rapid death.

Exclusion Criteria

No recommendations

Patient Management

Assessment

1. Remove patient from toxic environment when rescuers are properly trained and equipped.
2. Assess ABCDs and, if indicated, expose the patient, and then re-cover the patient to assure retention of body heat.
3. Assess vital signs including temperature and pulse oximetry
(which may not correlate with tissue oxygenation in cyanide/smoke exposure).
4. Attach a ECG cardiac monitor and obtain a 12-lead ECG
5. Check blood glucose level
6. Monitor pulse oximetry and $ETCO_2$
7. Monitor patient for signs of hypoxia (pulse oximetry less than 94%) and respiratory decompensation regardless of pulse oximetry reading.
8. Identify the specific agent of exposure, time of ingestion or inhalation, and quantity or timing of exposure.
9. Obtain patient history including cardiovascular history and prescribed medication.
10. Obtain other pertinent patient history.
11. Perform physical exam.

Treatment and Interventions

Treatment decisions must be made on the basis of clinical history and signs and symptoms of cyanide intoxication.

For the patient with an appropriate history and manifesting one or more significant cyanide exposure signs or symptoms:

1. Treat with 100% oxygen via non-rebreather mask or bag valve mask.
2. Administer one of the following medication regimes:
    a. **Hydroxocobalamin (preferred agent)*[PARA/Interfacility]***
        - Adult: 5 grams IV/IO administered over 15 minutes
        - Pediatric: 70mg/kg (max 5g) IV/IO administered over 15 minutes
    b. **CyanoKit *[PARA/Interfacility]***
        - **Sodium Nitrate*[PARA/Interfacility]***
            - Adult: 300mg IV/IO over 5 minutes
            - Pediatrics: 6mg/kg IV/IO over 5 minutes
        - **Sodium Thiosulfate*[PARA/Interfacility]***
            - Adult: 12.5g IV/IO
            - Pediatric: 0.5g/kg IV/IO (max 12.5g)
3. Treat seizures per Seizures guideline.

Patient Safety Considerations

- In the event of multiple casualties, be sure to wear appropriate PPE during rescue evacuation from the toxic environment.
- If the patient ingests cyanide, it will react with the acids in the stomach generating hydrogen cyanide gas. Be sure to maximize air circulation in closed spaces (ambulance) as the patient's gastric contents may contain hydrogen cyanide gases when released with vomiting or belching.
- Do not use nitrites in conjunction with suspected carbon monoxide poisoning as it worsens the hemoglobin oxygen carrying capacity even more than carbon monoxide (CO).
- Hydroxocobalamin is the only agent safe for treatment of cyanide poisoning in pregnant patient.

Notes and Educational Pearls

Key Considerations

- Pulse oximetry accurately reflects serum levels of oxygen but does not accurately reflect tissue oxygen levels; therefore, it should not be relied upon in possible cyanide and/or carbon monoxide toxicity.
- After hydroxocobalamin has been administered, pulse oximetry levels are no longer accurate.
- If the patient ingests cyanide, it will react with the acids in the stomach generating hydrogen cyanide gas. Be sure to maximize air circulation in closed spaces (ambulance) as the patient's gastric contents may contain hydrogen cyanide gases when released with vomiting or belching.

Pertinent Assessment Findings

- Early and repeated assessment is essential

Quality Improvement

Associated NEMSIS Protocol(s) (eProtocol.01)

- 9914043—Exposure-Cyanide

Key Documentation Elements

- Repeat evaluation and documentation of signs and symptoms as the patient's clinical condition may deteriorate rapidly

- Identification of possible etiology of poisoning
- Time of symptom onset and time of initiation of exposure-specific treatments
- Therapy and response to therapy

Performance Measure

- Early airway management in the rapidly deteriorating patient
- Accurate exposure history
    - Time of ingestion or exposure
    - Route of exposure
    - Quantity of medication or toxin taken (safely collect all possible medications or agents)
    - Alcohol or other intoxicant taken
- Appropriate protocol selection and management
- Multiple frequent documented reassessments

References

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