Carbon Monoxide or Smoke Inhalation

Aliases

CO

Patient Care Goals

1. Remove patient from toxic environment.
2. Assure adequate ventilation, oxygenation and correction of hypoperfusion.
3. Consider use of environmental carbon monoxide (CO) monitors on "first in" bags to assist in detection of occult CO toxicity.

Patient Presentation

Carbon monoxide is a colorless, odorless gas which has a high affinity for binding to red cell hemoglobin, thus preventing the binding of oxygen to the hemoglobin, leading to hypoxia (pulse oximetry less than 94%). A significant reduction in oxygen delivery to tissues and organs occurs with carbon monoxide poisoning. Carbon monoxide is also a cellular toxin which can result in delayed or persistent neurologic sequelae in significant exposures. With any form of combustion (fire or smoke [e.g. propane, kerosene, or charcoal stoves or heaters], combustion engines [e.g. generators, lawn mowers, motor vehicles, home heating systems]), carbon monoxide will be generated. People in a fire may also be exposed to cyanide from the combustion of some synthetic materials. Cyanide toxicity may need to be considered in the hemodynamically unstable patient removed from a fire.

Inclusion Criteria

1. Patients exposed to carbon monoxide may present with a spectrum of symptoms:
    a. Mild intoxication:
        i. Nausea
        ii. Fatigue
        iii. Headache
        iv. Vertigo
        v. Lightheadedness
    b. Moderate to severe:
        i. Altered mental status
        ii. Tachypnea
        iii. Tachycardia
        iv. Convulsion
        v. Cardiopulmonary arrest

Exclusion Criteria

No recommendations

Patient Management

Assessment

1. Remove patient from toxic environment by rescuers who are properly trained and equipped.
2. Assess ABCDs and, if indicated, expose patient and re-cover to assure retention of body heat.
3. Monitor vital signs including pulse oximetry, temperature, and $ETCO_2$ if available.
    1. Pulse oximetry is often falsely elevated in carbon monoxide poisoning
4. Consider SPCO monitoring, if available.
    1. Levels of 0-5% typically normal in non-smokers, levels of 5-10% typically normal in smokers
    2. Even if levels within typical normal, administer high-flow oxygen
    3. Levels can be helpful in triage when multiple patients present

5. Apply an ECG cardiac monitor and obtain a 12-lead ECG if available.
6. Check blood glucose level
7. Monitor pulse oximetry and $ETCO_2$ for respiratory decompensation.
8. Obtain pertinent patient history.
9. Conduct patient physical examination.

Treatment and Interventions

1. Administer **100% oxygen via non-rebreather mask or bag valve mask** or advanced airway as indicated.
2. Treat seizures per Seizures guideline.
3. Consider transporting patients with severe carbon monoxide poisoning directly to a facility with hyperbaric oxygen capabilities, if feasible and patient does not meet criteria for other specialty care (e.g. trauma or burn).

Patient Safety Considerations

- Consider affixing a carbon monoxide detector to an equipment bag that is routinely taken into scene (if it signals alarm, don appropriate respiratory protection and exit scene) to assist with detection of occult CO toxicity.
- Remove patient and response personnel from potentially hazardous environment as soon as possible.
- Prohibit the patient, the patient's family, and other appropriate bystanders from entering the environment (e.g. building, car) where the carbon monoxide exposure occurred until the source of the poisoning has been eliminated.
- Do not look for cherry red skin coloration as an indication of carbon monoxide poisoning, as this is an unusual finding.
- Transport all patients with probable or suspected CO poisoning to the nearest appropriate hospital based on their presenting signs and symptoms. Do not depend on CO oximeter devices, as they may yield inaccurate results for patients with CO poisoning.

Notes and Educational Pearls

Key Considerations

- Pulse oximetry is inaccurate due to the carbon monoxide binding with hemoglobin.
- Pregnant patients are more likely to be treated successfully with hyperbaric oxygen as maternal carboxyhemoglobin levels do not accurately reflect fetal carboxyhemoglobin levels.
- Consider cyanide toxicity if carbon monoxide poisoning is from a fire.
- A patient light wavelength analysis device to detect carboxyhemoglobin is useful to indicate if there is a carbon monoxide exposure in a non-arrested patient. Do not anticipate an immediate change in readings with oxygen administration.

Pertinent Assessment Findings

- Early and repeat assessment of patient's mental status and motor function are extremely useful in determining response to therapy and the need for hyperbaric therapy.
- Identification and documentation of possible etiology of poisoning
- Time of symptom onset and time of initiation of exposure-specific treatment
- Response to therapy

Quality Improvement

- **Associated NEMSIS Protocol(s) (eProtocol.01)**
    - 9914167—Exposure-Carbon Monoxide
    - 9914173—Exposure-Smoke Inhalation

Key Documentation Elements

- If using an environmental carbon monoxide detector, record the level detected.
- Document evidence of soot or burns around the face, nares or pharynx.
- Record early and repeat assessment of patient's mental status and motor function. This is extremely useful in determining response to therapy and the need for hyperbaric therapy
- Obtain accurate exposure history
    - Time of ingestion or exposure
    - Route of exposure
    - Quantity of medication or toxin taken (safely collect all possible mediations or agents)
    - Alcohol or other intoxicant taken
- Describe signs and symptoms of other patients encountered at same location, if present.

Performance Measures

- 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 mediations or agents)
    - Alcohol or other intoxicant taken
- Appropriate protocol selection and management
- Multiple, frequently documented reassessments

References

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