

**Target Audience:** Emergency Medicine Residents, Medical Students

**Primary Learning Objectives:**

1. Recognize life-threatening complications in house fire victim
2. Recognize and immediately treat complications of smoke inhalation
3. Treat a house fire patient with critical illness in systematic way addressing airway, breathing, and circulation
4. Search for injuries and possible traumatic cause of seizure
5. Seek out and consider all possible causes of acute altered mental status and demonstrate approach for evaluation of patient with altered mental status
6. Follow appropriate treatment algorithm for toxicological sequelae of smoke inhalation

**Secondary Learning Objectives: detailed technical/behavioral goals, didactic points**

1. Obtain HPI/PMH information on patient, if possible (chart review prior visits, speak with EMS)
2. Obtain information from EMS regarding details of fire and patient's rescue, as well as patient's state on EMS arrival and any interventions in the field
3. Identify team leader and recruit additional resources and personnel
4. Assign team roles
5. Exercise communication strategies to lead team in resuscitation of critically ill patient

**Critical actions checklist:**

1. Provide empiric treatment for carbon monoxide
2. Perform patient examination
3. Perform early endotracheal intubation
4. Exclude alternative etiologies for seizure
5. Obtain appropriate diagnostics
6. Provide empiric treatment for cyanide poisoning
7. Obtain appropriate consultations
8. Admit/transfer to the appropriate facility for definitive care

**Environment:**

1. Room Set Up – ED critical care area
  - a. Manikin Set Up – Mid or high fidelity pediatric simulator, simulated sweat
  - b. Props – Standard ED equipment

**For Examiner Only**

**CASE SUMMARY**

**SYNOPSIS OF HISTORY/ Scenario Background**

The setting is an urban emergency department.

Patient is a 26-year-old male with no known PMH who is brought in by EMS from scene of a house fire, unconscious at the scene, status-post witnessed generalized tonic-clonic movements while en route to ED. Per fire and rescue on scene, patient was found unconscious in basement location, away from site of live flames consuming 1<sup>st</sup> and 2<sup>nd</sup> stories of house above. Patient is without direct signs of trauma.

PMHx: No known PMH

PSHx: None

Medications: None

Allergies: NKDA

SocHx: Unknown

[Patient brought in by EMS unconscious from house fire, triaged to trauma bay.]

**SYNOPSIS OF PHYSICAL**

Patient is minimally arousable on arrival, inconsistently withdraws to pain, no vocalizations, no eye opening.

Patient was incontinent of urine.

No burns or external signs of trauma.

Patient with gurgling secretions and saliva that clear after suctioning.

Pupils equal and reactive.

## For Examiner Only

### CRITICAL ACTIONS

#### 1. Provide empiric treatment for carbon monoxide toxicity

Provide empiric treatment for carbon monoxide toxicity. This treatment, at a minimum, includes high-flow supplemental oxygen; other considerations include early endotracheal intubation and consultation/transfer for hyperbaric therapy (see below).

**Cueing Guideline:** The nurse can ask if the doctor knows what is causing the patient's symptoms, and if there is any empiric treatment.

#### 2. Perform patient examination

Perform patient examination after exposing the patient. To meet this critical action, a comprehensive physical examination, including neurologic examination, needs to be performed during the case play.

**Cueing Guideline:** The nurse can ask if the doctor wants to examine the patient.

#### 3. Perform early endotracheal intubation

Perform early endotracheal intubation. The need for early endotracheal intubation will be evident based on this patient's altered mental status and need for airway protection. Early endotracheal intubation will also help meet other critical actions (high-flow supplemental oxygen administration as empiric treatment for carbon monoxide toxicity).

**Cueing Guideline:** Nurse asks the doctor if he is concerned about this patient's airway given the patient's mental status.

#### 4. Exclude alternative etiologies for seizure

Exclude alternative etiologies for seizure. When the patient seizes during the case, the participant needs to consider etiologies like traumatic intracranial hemorrhage, hypoglycemia, hypoxia, etc.

**Cueing Guideline:** The nurse can ask if the doctor would like to do anything about the seizures when they occur. The nurse may say, "Doc, why do you think he had a seizure?"

#### 5. Obtain appropriate diagnostics

Obtain appropriate diagnostic studies. **As a minimum, these must include point-of-care co-oximetry, glucose, and a serum lactate.** Additional diagnostics, at faculty discretion, may also be considered appropriate and essential for patient management (e.g., basic metabolic panel, cardiac enzymes, anti-epileptic drug levels, etc.)

**Cueing Guideline:** The nurse can ask if the doctor would like to do anything about the seizures when they occur.

## 6. Provide empiric treatment for cyanide poisoning

Provide empiric treatment for suspected coexistent cyanide poisoning. Suspicion of coexistent cyanide poisoning should be raised in a patient with altered mental status, seizures, cardiac arrest, and profound lactic acidosis following significant exposure to fire or combustion. This critical action would be met by empiric administration of sodium thiosulfate or hydroxocobalamin (but would not, in this context, be met by amyl nitrite or sodium nitrite administration).

**Cueing Guideline:** The nurse can ask if the doctor would like to do anything about the seizures (when they occur) or suspected cyanide toxicity (if verbalized). Alternatively, the nurse could ask “Doctor, Would you like anything else for the patient? We have an antidote box available if you need it.”

## 7. Obtain appropriate consultations

Obtain appropriate consultations (e.g., Poison Center, Toxicologist, and/or Hyperbaric Medicine specialist).

**Cueing Guideline:** The nurse can ask if the doctor can do anything to minimize the delayed sequelae of this patient’s poisoning.

## 8. Admit/transfer to the appropriate facility for definitive care (MICU, hyperbaric facility)

Admit/transfer to the appropriate facility for definitive care. Depending on the participant’s institutional capabilities, this critical action may be met by admission/transfer for MICU admission and hyperbaric therapy. Patient will not be stable for any other destination (e.g. telemetry or floor unit). Any attempt to admit elsewhere will be blocked by accepting physician.

**Cueing Guideline:** The nurse can ask the doctor if anyone has called the intensivist to arrange for a definitive disposition decision.

## Critical Actions Checklist<sup>1</sup>

Resident Name									
Case Description									
<b>Skills measured</b> <small>Core competencies: PC Patient care, MK Medical knowledge, IC Interpersonal and communication skills                      P Professionalism, PB Practice-based learning and improvement                      SB Systems-based practice</small>	<b>Very Unacceptable</b>		<b>Unacceptable</b>		<b>Acceptable</b>		<b>Very Acceptable</b>		
<b>Data Acquisition (D)</b> PC MK I	1	2	3	4	5	6	7	8	
<b>Problem Solving (S)</b> PC MK PB	1	2	3	4	5	6	7	8	
<b>Patient Management (M)</b> PC MK IC P PB SB	1	2	3	4	5	6	7	8	
<b>Resource Utilization (R)</b> PC PB SB	1	2	3	4	5	6	7	8	
<b>Health Care Provided (H)</b> PC SB	1	2	3	4	5	6	7	8	
<b>Interpersonal Relations (I)</b> IC P	1	2	3	4	5	6	7	8	
<b>Comprehension of Pathophysiology (P)</b> MK PB	1	2	3	4	5	6	7	8	
<b>Clinical Competence (C)</b> PC MK IC P PB SB	1	2	3	4	5	6	7	8	
<b>Critical Actions</b>									
<b>Yes</b>	<b>No</b>				<b>Comments:</b>				
		Provide empiric treatment for carbon monoxide							
		Perform patient examination							
		Perform early endotracheal intubation							
		Exclude alternative etiologies for seizure							
		Obtain appropriate diagnostics							
		Provide empiric treatment for cyanide poisoning							
		Obtain appropriate consultations			<b>Yes</b>	<b>No</b>			
		Admit/transfer to the appropriate facility for definitive care			<input type="checkbox"/>	<input type="checkbox"/>	<b>Dangerous actions</b>		

<sup>1</sup> Modified ABEM Oral Certification Examination checklist and scoresheet

**For Examiner Only**

**HISTORY**

You are called to see a new patient (26-year-old male) brought in by EMS from site of a fire. He is minimally responsive-to-unresponsive on arrival and tachycardic. **EMS informs you patient had a seizure during transport.**

**Onset of Symptoms:** Acute

**Background Info:** If EMS queried, patient young and reportedly otherwise healthy per neighbor at the scene. Mother of burn victim was transported to other critical care trauma facility from the fire.

**Additional History**

From EMS: If asked about the events at the scene, EMS will inform team that patient was found unresponsive in basement of house, away from flames that had engulfed the first and second floor of the house on their arrival.

**Chief Complaint:** Unconscious, witnessed seizure, arrival from house fire

**Past Medical Hx:** No known PMH

**Past Surgical Hx:** Unknown

**Habits:** Unknown

**Family Med Hx:** Unknown

**Social Hx:** Unknown

**ROS:** Patient is unable to answer.

**Vital Signs:** **BP: 114/68 mmHg P: 132/minute R: 22/minute T: 37 C (98.6F) POx: 99% (FiO<sub>2</sub>=0.21)**

**Primary Survey**

Airway – Patent after suctioning of gurgling secretions on arrival

Breathing – Mild tachypnea, 98-100% Pox on room air on arrival.

Circulation – Tachycardia (130's), SBP 110's

Disability – Incontinent of urine. Minimally responsive-to-unresponsive: inconsistently withdraws to pain, no vocalizations, no eye opening.

Exposure – No signs of external trauma or burns.

## Required Actions within the First Two Minutes

- Immediate placement of high-flow supplemental oxygen using nonrebreather mask
- Establish safety net (IV, oxygen, cardiac monitor, two large bore IVs, draw blood for labs)
- A/B – Oxygen, airway assessment - gurgling secretions, consider early intubation
- C – cardiac monitor; 2L NS IV bolus
- D – Finger stick glucose = 130mg/dL

## Branch Points

- **IF EARLY ENDOTRACHEAL INTUBATION IS NOT PERFORMED WITHIN THE FIRST TWO MINUTES – OR – IF PATIENT IS NOT PLACED ON SUPPLEMENTAL OXYGEN BY NONREBREATHER MASK**, then the respiratory status will continue to worsen and the patient will demonstrate increased gurgling secretions.
- **IFA POINT-OF-CARE GLUCOSE IS NOT PERFORMED WITHIN THE FIRST TWO MINUTES**, the patient will begin to seize again.

## CASE CONTINUATION - PHYSICAL EXAM

**General Appearance:** Unresponsive.

**Vital Signs:** **BP: 114/68 mmHg P: 132/minute R: 22/minute T: 37 C (98.6F) POx: 99%**

**Head:** Normal, atraumatic

**Eyes/Ears:** PERRLA, pupils 3 mm bilaterally. TM's normal.

**Mouth:** No signs of soot or ash. Mildly dry mucous membranes and lips, audible and visible gurgling saliva and secretions

**Neck:** No deformity on exam. No stridor

**Skin:** No signs of trauma, no rashes appreciated

**Chest:** Increased respiratory rate without any signs of distress (no retractions)

**Lungs:** Clear, equal bilaterally. No wheezing

**Heart:** Tachycardic, S1 S2, no murmurs

**Back:** Normal

**Abdomen:** Soft, no signs of trauma, no rebound/guarding

**Extremities:** No signs of trauma, no edema, pulses are present

**Rectal:** Normal tone, guaiac negative

**Neurological:** Inconsistent exam, GCS6 (E1V1M4) however patient inconsistently withdrawing to pain at times on exam also. No clonus. PERRLA, non-deviated.

**Mental Status:** Unable to assess due to AMS

### Required Actions over the Next Two Minutes

- Oxygen saturation remains 98-100%
- Point-of-care co-oximetry reveals carboxyhemoglobin level 65%

### Required Actions over the Next Two Minutes

- Diagnostics should be returned as ordered, including lactate and carboxyhemoglobin
- Carbon monoxide toxicity should have been recognized by this time
- Coexistent cyanide toxicity should be considered at this time
- If the patient has seized, then causes of status epilepticus should be considered at this time
- Airway and Breathing should have been addressed by this time
- Poison Center/Toxicology /Hyperbaric Medicine consultations should be considered at this time

### Branch Points

- **IF THE CARBON MONOXIDE OR CYANIDE TOXICITIES ARE NOT TREATED OR CONSIDERED BY THIS TIME**, then the patient will develop PEA arrest.
- **IF THE PATIENT DEVELOPS PEA ARREST**, return of spontaneous circulation (ROSC) will be achieved when the patient is given an appropriate antidote and two cycles of CPR have been performed.

### Required Actions over the Next Two Minutes

- Identification of elevated carboxyhemoglobin level and maximum oxygen delivery should have been performed by this time
- Call and arrange for hyperbaric therapy. Confirm chamber can handle intubated patient
- Must consult medical toxicology
- If lactate not ordered, identify need for lactate and order and act upon it (treat for clinical diagnosis of CN toxicity)
- If sent, recognize elevated lactate and clinical diagnosis of CN toxicity and start hydroxocobalamin (5 gm IV bolus; **this is favored**) or sodium thiosulfate (12.5 gm IV bolus)

### Branch Points

- **IF THE HYDROXOCOBALAMIN OR SODIUM THIOSULFATE IS ADMINISTERED**, then the patient will demonstrate a ROSC if cardiac arrest has occurred.
- **IF HYPERBARIC MEDICINE SPECIALIST/FACILITY IS NOT CONSULTED**, then the local MICU will not accept the patient and will make this recommendation.

### **Required Actions over the Final Two Minutes**

- Final disposition of admission to hyperbaric facility if locally available or transfer to nearby facility with hyperbaric capabilities (confirm chamber can handle intubated patient).

**For Examiner Only**

**STIMULUS INVENTORY**

- #1 Complete blood count
- #2 Basic metabolic panel
- #3 Urinalysis
- #4 Liver function tests
- #5 Venous blood gas
- #6 Cardiac enzymes
- #7 Toxicology
- #8 Coagulation studies
- #9 Point-of-care serum glucose
- #10 ECG

**For Examiner Only****LAB DATA & IMAGING RESULTS**

<b>Stimulus #1</b>	
<b>Complete Blood Count (CBC)</b>	
WBC	15,500/mm <sup>3</sup>
Hemoglobin	13.1 g/dL
Hematocrit	40%
Platelets	241,000/mm <sup>3</sup>
Differential	
PMNLs	45%
Lymphocytes	55%
Monocytes	2%
Eosinophils	1%

<b>Stimulus #2</b>	
<b>Basic Metabolic Profile (BMP)</b>	
Sodium	140 mEq/L
Potassium	3.8 mEq/L
Chloride	102 mEq/L
Bicarbonate	8 mEq/L
Glucose	73 mg/dL
BUN	15 mg/dL
Creatinine	1.1 mg/dL

<b>Stimulus #3</b>	
<b>Urinalysis</b>	
Color	Yellow
Specific gravity	1.017
Glucose	Negative
Protein	Negative
Ketones	Trace
Leuk. Esterase	Negative
Nitrites	Negative
WBC	3/hpf
RBC	2/hpf

<b>Stimulus #4</b>	
<b>Liver Function Tests</b>	
AST	49 U/L
ALT	32 U/L
Alk Phos	110 U/L
T. Bilirubin	1.2 mg/dL
Albumin	4.3 mg/dL
Protein	7 mg/dL

<b>Stimulus #5</b>	
<b>Venous Blood Gas</b>	
pH	7.0
pCO <sub>2</sub>	25 mm Hg
pO <sub>2</sub>	40 mm Hg
HCO <sub>3</sub>	8 mEq/L
Lactate	12 mmol/L

<b>Stimulus #6</b>	
<b>Cardiac Enzymes</b>	
Troponin	0.025 ng/mL

<b>Stimulus #7</b>	
<b>Toxicology</b>	
Salicylate	< 4 mg/dL
Acetaminophen	< 10 mcg/mL
Ethanol	Undetectable
<b>Urine drug screen</b>	
Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCA's	Negative
THC	Negative

<b>Stimulus #8</b>	
<b>Radiology</b>	
CXR	Normal
CT head	Normal

<b>Stimulus #9</b>	
<b>Carboxyhemoglobin</b>	
65%	

**Stimulus #1****Complete Blood Count (CBC)**

WBC	15,500/mm <sup>3</sup>
Hemoglobin	13.1 g/dL
Hematocrit	40%
Platelets	241,000/mm <sup>3</sup>
Differential	
PMNLs	45%
Lymphocytes	55%
Monocytes	2%
Eosinophils	1%

**Stimulus #2****Basic Metabolic Profile (BMP)**

Sodium	135 mEq/L
Potassium	4.0 mEq/L
Chloride	106 mEq/L
Bicarbonate	20 mEq/L
Glucose	100 mg/dL
BUN	48 mg/dL
Creatinine	1.0 mg/dL

**Stimulus #3****Urinalysis**

Color	Yellow
Specific gravity	1.017
Glucose	Negative
Protein	Negative
Ketones	Trace
Leuk. Esterase	Negative
Nitrites	Negative
WBC	3/hpf
RBC	2/hpf

**Stimulus #4****Liver Function Tests**

AST	49 U/L
ALT	32 U/L
Alk Phos	110 U/L
T. Bilirubin	1.2 mg/dL
Albumin	4.3 mg/dL
Protein	7 mg/dL

**Stimulus #5****Venous Blood Gas**

pH	7.0
pCO <sub>2</sub>	25 mm Hg
pO <sub>2</sub>	40 mm Hg
HCO <sub>3</sub>	8 mEq/L
Lactate	12 mmol/L

**Stimulus #6**  
**Cardiac Enzymes**

Troponin	0.025 ng/mL
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**Stimulus #7****Toxicology**

Salicylate	< 4 mg/dL
Acetaminophen	< 10 mcg/mL
Ethanol	Undetectable

**Urine drug screen**

Amphetamines	Negative
Benzodiazepines	Negative
Cocaine	Negative
Opiates	Negative
TCAs	Negative
THC	Negative

**Stimulus #8**

**Radiology**

CXR	Normal
CT head	Normal

**Stimulus #9**  
**Carboxyhemoglobin**

65%

**Stimulus #10**

<b>ECG</b>	Sinus bradycardia
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## Debriefing Materials – CO/CN Toxicity

CO and CN are both highly toxic lethal compounds. Smoke inhalation victims, such as the patient in this case, present a major challenge as they may have been exposed to either or both CO and CN.

### Sources of Exposure:

- CO poisoning are much more likely to occur in winter in areas with colder climate due to defective household heating sources and improper use of cooking equipment in enclosed spaces.
- Cyanide poisoning is most often linked to house fires and combustion of products containing carbon and nitrogen, primarily foam rubber, wool, plastics, and other synthetic materials.

### Pathophysiology:

#### CO

- CO is an odorless, tasteless, colorless gas that is created with incomplete combustion of fuels.
- CO is inhaled in the lungs, diffuses across alveolar barriers, and binds to hemoglobin to form carboxyhemoglobin.
- CO has an affinity for hemoglobin 210 times higher than O<sub>2</sub> leading to leftward shift on the hemoglobin-oxygen dissociation curve. This leads to decreased release of oxygen from hemoglobin resulting in cellular hypoxia.
- CO also inhibits O<sub>2</sub> supply to mitochondria in myocardial cells, causing injury to the myoglobin.
- The systems most affected by CO include those most affected by hypoxia: heart and CNS.
  - Treatment for CO poisoning is oxygen! O<sub>2</sub> competitively displaces CO from hemoglobin.
    - Room air, this process takes 300 minutes.
    - 100% nonrebreather mask, process decreased to 60-90 minutes.
    - Hyperbaric oxygen therapy, process decreased to 30 minutes.

#### CN

- CN disrupts the electron transport chain in the mitochondrial production of ATP by binding to and inhibiting cytochrome oxidase a.
- As aerobic cellular metabolism ceases, cells are forced into anaerobic metabolism with the subsequent generation of lactate.
- This causes profound acidosis and very elevated lactate levels, quickly resulting in cellular death.
- Similar to CO toxicity, the most quickly and severely affected organs are the heart and CNS.

### Signs and Symptoms:

- CO:
  - 10-20: headache, fatigue, nausea, shortness of breath
  - 20-40: Irritability, impaired judgment, vertigo, chest pain
  - 40-50: Confusion, LOC
  - 50+: Medical examiner cutoff for CO as cause of death

- 60-70: Unconsciousness, seizures, CV collapse, stroke, and death.
- 80+: Rapidly fatal
- CN:
  - Mild: Nonspecific complaints such as headache, nausea, vertigo, anxiety, altered mental status, hypertension.
  - Severe: Unconsciousness, seizures, cardiovascular collapse such as shock, pulmonary edema, and ultimately death.

### **Diagnostic Testing:**

- Standard pulse oximetry
  - Unreliable as it does not distinguish between wavelengths caused by refractions of hemoglobin vs. carboxyhemoglobin vs. methemoglobin.
- Bedside pulse co-oximetry
  - Able to distinguish waveform types
  - Bedside so easily accessible and near instant results
  - Inconsistently reliable readings. Rule of thumb: If elevated, proceed under assumption true level is that reading or even higher. If normal, confirm with blood test level.
- Carboxyhemoglobin levels:
  - Normal: 2-5% in nonsmokers, 5-13% in smokers
  - Pregnant women require special consideration as fetal hemoglobin may be present and as high as 30% at 3 months, which translates to a carboxyhemoglobin level of approximately 7%.
  - Dangerous levels are considered those > expected values with level >25% utilized as indication for hyperbaric therapy.
  - Keep in mind normal carboxyhemoglobin levels may be present in those who have already received oxygen (e.g., from EMS) or as time passes from exposure to time of checking level.
- Lactate levels:
  - Within normal limits or mild elevation, more consistent with CO poisoning alone.
  - Aids clinical diagnosis with rule of thumb for diagnosis of CN toxicity of:
    - Lactate > 8 mmol/L in victims without smoke inhalation
    - Lactate > 11 mmol/L in victims with concomitant smoke inhalation
- CBC:
  - Mild leukocytosis may be seen with CO poisoning
- VBG:
  - Normal to elevated PaO<sub>2</sub> level (very high levels of PaO<sub>2</sub> suggestive of CN poisoning, reflection of cell's inability to extract and use oxygen)
  - Mild acidosis with CO poisoning, Severe acidosis with CN poisoning.
- Cardiac biomarkers:
  - Myocardial infarction is due to direct CO myocardial toxicity and is prognostic for in-hospital fatality.
  - May also be elevated secondary to ischemia from hypoxia or from ischemia with lactic acidosis.
- Obtain hepatic, renal, and coagulation profiles, as well as creatinine kinases levels to address possible underlying end organ dysfunction in patients with moderate-to-severe toxicity

**Treatment:**

- CO exposure/toxicity
  - Remove victim from scene ASAP.
  - Immediately administer 100% O<sub>2</sub> via nonrebreather mask, noninvasive positive pressure ventilation, or endotracheal ventilation.
  - Goal of oxygen intervention is a carboxyhemoglobin level <5%.
  - Hyperbaric oxygen therapy is indicated if there is any of the following: end-organ injury (e.g., myocardial infarction, seizure), LOC at scene, carboxyhemoglobin level >25%, level >15% in pregnant women, neurological deficits, ongoing symptoms (e.g., chest pain, altered mental status). Consider HBO also if the patient is older (age >50), or has ongoing symptoms despite 100% O<sub>2</sub>.
  - Hyperbaric research is somewhat controversial at this time. Proponents argue there is a decrease in long-term neuropsychiatric sequelae.
  - In 2008, ACEP issued a level C recommendation for hyperbaric therapy for CO toxicity.
- CN exposure/toxicity
  - Similar to CO, immediate removal from source.
  - Antidote use: choice of antidote (hydroxocobalamin or sodium thiosulfate) is often institution-specific. Several studies suggest both are efficacious for treating CN poisoning.
  - Amyl/sodium Nitrite should not be administered in this case due to concomitant CO poisoning.
  - Hydroxocobalamin administration may result in flushing, hypertension, and problems with interpretation of laboratory results that use colorimetric testing.
- As with all patients, remember to assess and manage concomitant injuries, for example possible traumatic injuries.

**Consultations:**

- Consult the regional poison center or a local medical toxicologist for additional information and patient care recommendations.
- Consult hyperbaric specialist and facility.
  - Hyperbaric therapy may be considered for CO poisoning with:
    - Carboxyhemoglobin level >25%
    - Evidence of cardiac involvement
    - Severe acidosis
    - Transient or prolonged unconsciousness
    - Neurologic impairment (for example, seizures as present in this case)
    - Patients 36 years of age or older
    - Pregnant women

**Disposition:**

- Admit patients with major signs and symptoms to an ICU.
- Consult and consider admission or transfer to hyperbaric unit when indicated.

**Take-Home Points:**

- CO and CN toxicity can both be present in victims of smoke inhalation.
- Medical providers must always maintain a high index of suspicion for these toxic compounds in all victims of smoke inhalation.

- CO poisoning can be diagnosed with detection of carboxyhemoglobin levels in blood or bedside point of care co-oximetry.
- Carboxyhemoglobin level does not correlate with level of severity of toxicity.
- CN toxicity remains a clinical diagnosis and there is no specific and quick bedside lab confirmatory test, although lactate levels assist greatly.
- Blood lactate levels > 8 mmol/L in non-smoke inhalation victims and > 11 mmol/L in smoke inhalation victims are considered diagnostic of CN toxicity.
- Initial treatment for CO exposure/toxicity is administration of 100% oxygen.
- Hyperbaric oxygen is an adjunct treatment which should be considered but benefits of hyperbaric therapy remain controversial.
- CN treatment options include hydroxocobalamin, sodium thiosulfate, and amyl/sodium nitrite.
- Both hydroxocobalamin and sodium thiosulfate can be given with suspected concomitant CO and CN toxicity; however, amyl and sodium nitrites can cause methemoglobinemia and hypotension and are, therefore, not recommended with concomitant CO poisoning.

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