Monitoring CO Poisoning with the Rad-57™

Includes a review on Carbon Monoxide Poisoning For Emergency Responders

V.8  1 May 2011
IMPORTANT NOTICE

- This program is not meant as a substitute for a program or course of study in carbon monoxide recognition and treatment, or emergency medicine. This is for review only. Please refer to your physician or local Medical Director for approved content and medical protocols.

- This program is not meant as a substitute for the manufacturer’s operator manual for the Masimo Rad-57. Please refer to the manufacturer for complete operating instructions.
Introduction

Using the RAD-57 Pulse CO-Oximeter

- Note: This is NOT intended to replace or act as a substitute for the Operators Manual. Please refer to the manufacturer’s Operator Manual for complete information on the operation and safety of the RAD-57 Pulse CO-Oximeter.
RAD-57 EMS Carry Case

- Water resistant, protective case
  - Extra sensor pocket
  - Reference card holder
  - Pen holder
  - Spare battery pocket

- For maximum protection, the device MUST remain in the protective case during field use.
Powering Up

- **POWER**
  - Press to turn ON
  - Press and HOLD to turn OFF
  - Do NOT have to turn the device on/off in between readings!

- **Battery Life Indicator**
  - 4 Green LED’s
  - Each represents ~25% battery life
  - Do Not use rechargeable batteries

- **Battery Compartment**
  - Located on the back panel
  - Holds 4 AA alkaline batteries
  - Operates 8-10 hours
3 STEPS TO SENSOR PLACEMENT:

- **Step 1:** Select the appropriately sized sensor for the patient’s finger.

- **Step 2:** Carefully insert the patient’s finger into the sensor until it reaches the digit stop.

- **Step 3:** Shield the sensor in environments of excessive ambient light.
Sensor Placement Tips

- Use only the index, middle or ring fingers. Do NOT use toes.

- There is a top and bottom to the sensor; the cable should lay over the top of the hand

- Pedi sensors- small fingers; Adult sensors- average to large fingers.

- To reposition sensor or take additional readings, remove the sensor completely from the finger, then replace

- INCORRECT SENSOR PLACEMENT CAN CAUSE A FALSELY ELEVATED SpCO!
Startup Sequence

- Finger should be relatively clean & dry

- Calibration:
  - Display will scroll through alarm settings immediately upon start up
  - Takes ~10 seconds

- Calculation:
  - Display will show scrolling zeroes (0 – 0 – 0) followed by dashed lines
  - Takes ~20 seconds
  - Limit sensor movement during this phase

- Begin patient monitoring:
  - Defaults to SpO₂/ Pulse Rate screen
Measuring SpO₂ and Pulse Rate

- Pulse oximeter (SpO₂) reading on top in GREEN; heart rate on bottom in RED.
- SIQ- Signal Identification and Quality- identifies the quality of the SpO₂ signal.
- Press YELLOW “Bell” button to silence alarms.
- Press DISPLAY button to scroll through display screens
- Mode/Enter/Up & Down Arrows- for higher menu functions (i.e. change alarm settings or screen brightness)
Measuring SpCO

- Display after Startup:
  - Carboxyhemoglobin (SpCO) on top, in %
  - The letters ‘CO’ on bottom

- CONFIRM ALL ELEVATED SpCO READINGS by taking a total of 3 readings on 3 different fingers. Use the average of the three as the SpCO.

- If SpO₂ < 90% or SpMet > 2%, SpCO may NOT read if your sensor is Rev H or above.
  - Display will show dashed lines.

To determine what rev sensor you have:
Look at the letter stamped on the base of the sensor
Measuring PI

- Press the **DISPLAY** button to display the PI parameter.

- **PI = Perfusion Index.** A measurement of blood flow to the extremity the sensor is on.

- The same principal as capillary refill.

- Values range from 0.02-20. The lower the number, the lower the perfusion.

- Displayed both numerically and graphically.
Optional Features

- **Auto ON/OFF**
  - Can opt to turn device off after period of non use
  - 5, 10, 15 minutes

- **Perfusion Index (PI)**
  - Display can be turned on or off

- Can make SpCO the default display upon start up screen (instead of SpO\textsubscript{2}/pulse rate)
Light Shield Use

- The presence of intense ambient light can interrupt (no reading) or interfere (falsely elevate reading) with the SpCO reading.

- SHIELD THE SENSOR FROM INTENSE AMBIENT LIGHT!! This includes strobes and sunlight.

- Insert the sensor all the way into the light shield; ensure the cable comes out of the top of the opening.

- Once sensor is in place in the light shield, insert finger into sensor.
SpCO Accuracy

- The SpCO parameter has an accuracy of +/- 3% (for one standard deviation, which is 67% of patients)
  - Example: A reading of 4% could actually be between 1% - 7%

- Measurements may vary from reading to reading, even on the same patient, within the accuracy specification

- If an elevated SpCO is detected, **ALWAYS** confirm by measuring 2 additional fingers. Use the rough average of the readings as the person’s SpCO value.
Warnings and Cautions

- Good arterial perfusion along with correct sensor placement will provide a stable CO reading. Inaccurate measurements may be caused by:
  - Incorrect sensor placement
  - Hypoxemia, including altitude induced hypoxemia
  - Elevated levels of methemoglobin
  - Intense ambient light
  - Low arterial perfusion
  - Motion artifact
Carbon Monoxide Exposure: Treatment Algorithm

Suffolk County BLS Policies 2012 Edition Appendix XI

Measure SpCO

>=12%

YES

NO

Suffolk County BLS Policies 2012 Edition Appendix XI

TREAT with 100% oxygen and TRANSPORT to the closest emergency department

Signs of CO Exposure

NO

YES

No further medical monitoring needed if vitals are normal and atmospheric monitoring levels are within normal limits

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CO Poisoning Review

- Leading cause of poisoning deaths in United States and other industrialized countries
- 5000-6000 deaths annually in U.S.
- 50,000-60,000 ED admissions annually
Pathophysiology of CO Poisoning

• Impairs oxygen delivery resulting in cellular hypoxia

• CO binds to hemoglobin 230-270 times more avidly than oxygen resulting in carboxyhemoglobin (COHb)

• CO also binds to Myoglobin and Cytochromes disrupting storage of O2 in certain muscle cells and transfer of energy within cells
Pathophysiology of CO Poisoning (ctd.)

- Negative effect on central nervous system effecting cognitive abilities such as perception, reasoning, awareness, and judgment
- Negative effects on cardiovascular system by depressing myocardial function
- Respiratory system effected by potential damage to alveolar membranes
Signs and Symptoms of CO Poisoning

- Flu-like symptoms
- Headache
- Dizziness
- Fatigue
- Dyspnea
- Chest pain
- Palpitations
- Confusion
- Agitation
- Nausea
- Vomiting
- Abdominal pain

- Hypotension with tachycardia
- Cardiac dysrhythmias
- Myocardial ischemia
- Pulmonary edema
- Syncope
- Seizures
- Fecal/urinary incontinence
- Visual abnormalities
- Memory loss
- Coma
- Death
Exposure Risks

- Automobile exhaust fumes
- Propane-powered vehicle fumes
- House fires
- Heaters
- Indoor stoves
- Camp stoves
- Boat exhaust fumes
- Gas-powered electrical generators
- Cigarette smoke
- Charcoal-fired cook stoves
- Ovens
- Methylene chloride solvent inhalation (paint removers, adhesive removers)
Substances That Can Cause Methemoglobinemia

- **Inorganic agents**
  - Nitrates - Fertilizers, contaminated well water, preservatives, industrial products
  - Chlorates
  - Copper sulfate – Fungicides
  - Organic nitrites/nitrates
    - Amyl nitrite
    - sobutyl nitrite
    - Sodium nitrite
    - Nitroglycerin
    - Nitroprusside
    - Nitric oxide
    - Nitrogen dioxide
    - TNT

- **Others**
  - local anesthetics - Benzocaine, lidocaine, prilocaine, phenazopyridine (Pyridium)
  - Antimalarials - Primaquine, chloroquine
  - Antineoplastic agents - Cyclophosphamide, ifosfamide, flutamide
  - Analgesics/antipyretics - Acetaminophen, acetanilid, phenacetin, celecoxib
  - Herbicide – Paraquat
  - Antibiotics - Sulfonamides, nitrofurans, P-amino-salicylic acid, dapsone
  - Industrial/household agents - Aniline dyes, nitrobenzene, naphthalene (moth balls), aminophenol, nitroethane (nail polish remover)
Populations at Increased Risk

- Children
- Elderly
- Persons with heart disease
- Pregnant women (due to CO’s effect on fetus)
- Pt’s with increased O2 demand
- Pt’s with decreased O2-carrying capacity
- Pt’s with chronic respiratory insufficiency
- Miners
- Emergency personnel
- FIREFIGHTERS
## Normal COHb Levels

<table>
<thead>
<tr>
<th>Source</th>
<th>COHb (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Endogenous (normal heme catabolism)</strong></td>
<td>0.4-0.7</td>
</tr>
<tr>
<td><strong>Tobacco smokers:</strong></td>
<td></td>
</tr>
<tr>
<td>1 pack per day</td>
<td>5-6</td>
</tr>
<tr>
<td>2-3 packs per day</td>
<td>7-9</td>
</tr>
<tr>
<td><strong>Cigars</strong></td>
<td>Up to 20</td>
</tr>
<tr>
<td><strong>Urban commuter</strong></td>
<td>5</td>
</tr>
<tr>
<td><strong>Methylene chloride (100 ppm for 8 hours)</strong></td>
<td>3-5</td>
</tr>
<tr>
<td>PPM</td>
<td>Duration of exposure</td>
</tr>
<tr>
<td>------</td>
<td>----------------------</td>
</tr>
<tr>
<td>200</td>
<td>2-3 hours</td>
</tr>
<tr>
<td>400</td>
<td>1-2 hours</td>
</tr>
<tr>
<td>800</td>
<td>45 minutes</td>
</tr>
<tr>
<td>1600</td>
<td>20 minutes</td>
</tr>
<tr>
<td>3200</td>
<td>5-10 minutes</td>
</tr>
<tr>
<td>6400</td>
<td>1-2 minutes</td>
</tr>
<tr>
<td>12,800</td>
<td>1-3 minutes</td>
</tr>
</tbody>
</table>
## Signs and Symptoms vs. COHb Levels

<table>
<thead>
<tr>
<th>COHb</th>
<th>Severity</th>
<th>S and Sx</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;15-20%</td>
<td>Mild</td>
<td>H/A, N/V, dizziness, blurred vision</td>
</tr>
<tr>
<td>21-40%</td>
<td>Moderate</td>
<td>Confusion, syncope, chest pain, dyspnea, tachypnea, tachycardia, weakness</td>
</tr>
<tr>
<td>41-50%</td>
<td>Severe</td>
<td>Dysrhythmias, hypotension, cardiac ischemia, palpitations, respiratory arrest, pulmonary edema, seizures, coma, cardiac arrest</td>
</tr>
<tr>
<td>&gt;60%</td>
<td>Fatal</td>
<td>Death</td>
</tr>
</tbody>
</table>
Verification Form

To receive credit for the RAD-57 in-service training, complete and submit the training verification form.