Physiologic Aspects of Switching SCSRs in an IDLH Atmosphere

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Recent Coal Mine Disasters
The Role for Better SCSR’s
Example from Barakova Mine, Krasnodon Ukraine

- March, 11, 2000
- 80 Coal Miners Died
Коллектив трудящихся, профсоюзные комитеты и руководство шахты Н.П. Бакова глубоко скорбят по случаю трагической гибели трудящихся и выражает искренние соболезнования родным и близким погибших.

Список погибших
11 марта 2000 г.

[Список имен в таблице]
Carbon Monoxide Poisoning

- Many miners killed in recent disasters died from CO poisoning, not trauma or burns
- 5000-6000 deaths from CO in US/year
- CO in Environment is .001% or 10 ppm
- Amount of CO absorbed depends on:
  - Minute ventilation
  - CO, and O2 concentration
  - Duration of exposure
Carbon Monoxide Poisoning

- CO binds to Hgb with 200 times the affinity of O2
- Does not allow Hgb to release oxygen
- CO toxicity is more than just COHb
  - Damage to cellular enzymes
    - Cytochromes
    - Myoglobin
    - Guanyl Cyclase
Physiology of CO Intoxication

- CO exposure
- Rise in carboxyhemoglobin (COHb)
- The higher the CO level, the more severe the neurological symptoms will be:
  - headache, dizziness, weakness
  - nausea, vomiting, confusion
  - disorientation, and visual disturbances
Neurologic Impairment

- Impairment to the neurological system can compromise a person's judgment
  - Causes difficulty processing information and making critical decisions.

- The brain is quite sensitive to the effects of CO
  - Symptoms can emerge quite rapidly after exposure, especially at high levels occurring after a coal mine explosion when air flow is disrupted.
**Mild CO Poisoning – 15-20% COHb**

- Headache
- Nausea
- Vomiting
- Dizziness
- Blurred vision
Moderate CO Poisoning
20-60% COHb

- Confusion
- Syncope
- Chest pain
- Dyspnea
- Weakness
- Tachycardia
- Tachypnea
- Rhabdomyolysis
Severe CO Poisoning > 60% COHb

Note Charleston ME Office calls 45% COHb Lethal

- Palpitations
- Dysrhythmias
- Hypotension
- Myocardial ischemia
- Cardiac arrest
- Respiratory arrest
- Noncardiogenic pulmonary edema
- Seizures
- Coma
Carbon Monoxide Poisoning – CO Levels

- OSHA – 50 ppm for 8 hour work day
- Cooking indoors – up to 100 ppm
  - (> 100 ppm dangerous to human health)
- Breathing 70 ppm for 4 hours = COHb of 10%
- Breathing 350 ppm for 4 hours = COHb of 40%
- Smoking – 400-500 ppm while smoking
- Auto exhaust – 80,000 to 100,000 ppm
- Sago as high as 2600 ppm (426 ppm where miners were found, at the time they were found)
<table>
<thead>
<tr>
<th>Concentration</th>
<th>Symptoms</th>
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<tbody>
<tr>
<td>35 ppm (0.0035%)</td>
<td>Headache and dizziness within six to eight hours of constant exposure</td>
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<tr>
<td>100 ppm (0.01%)</td>
<td>Slight headache in two to three hours</td>
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<tr>
<td>200 ppm (0.02%)</td>
<td>Slight headache within two to three hours; loss of judgment</td>
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<td>400 ppm (0.04%)</td>
<td>Frontal headache within one to two hours</td>
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<tr>
<td>800 ppm (0.08%)</td>
<td>Dizziness, nausea, and convulsions within 45 min; insensible within 2 hours</td>
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<td>1,600 ppm (0.16%)</td>
<td>Headache, tachycardia, dizziness, and nausea within 20 min; death in less than 2 hours</td>
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<td>3,200 ppm (0.32%)</td>
<td>Headache, dizziness and nausea in five to ten minutes. Death within 30 minutes.</td>
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<td>6,400 ppm (0.64%)</td>
<td>Headache and dizziness in one to two minutes. Convulsions, respiratory arrest, and death in less than 20 minutes.</td>
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<tr>
<td>12,800 ppm (1.28%)</td>
<td>Unconsciousness after 2-3 breaths. Death in less than three minutes.</td>
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</table>
1: Kneel/Loop, Pull Orange Tag, Start Oxygen
2: Insert Mouthpiece
3: Affix Nosepiece
4: Put on Goggles
5: Adjust Strap
6: Put on Hat and move out
Starting SCSR’s and Transfers – need for dockable units

- Transfer SCSR's require breath holds, removal of mouthpieces and nose clips
- Some SCSR's require starter oxygen
  - If this fails requires 6 breaths from outside
  - Risk of exposure during the startup phase
- There is significant risk of inhaling toxic atmosphere during transfers
Treatment of Carbon Monoxide Poisoning

- 100% NB O2
- HBOT at 2.5 – 3.0 ATA
  - May reduce Delayed Neurologic Sequelae
  - May reduce overall mortality
  - 4/6 RCT’s showed benefit for HBOT
  - Still Controversial, but may benefit most patients with LOC, > 25% COHb, and Age > 50