Carbon Monoxide Poisoning in Children Riding in the Back of Pickup Trucks

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Objective.—To describe the case characteristics of a series of children poisoned with carbon monoxide while traveling in the back of pickup trucks.

Design.—Pediatric cases referred for treatment of carbon monoxide poisoning with hyperbaric oxygen between 1986 and 1991 were reviewed. Those cases that occurred during travel in the back of pickup trucks were selected. Clinical follow-up by telephone interview ranged from 2 to 55 months.

Setting.—A private, urban, tertiary care center in Seattle, Wash.

Patients.—Twenty children ranging from 4 to 16 years of age.

Intervention.—All patients were treated with hyperbaric oxygen.

Main Outcome Measures.—Characteristics of the poisoning incident and clinical patient outcome.

Results.—Of 68 pediatric patients treated for accidental carbon monoxide poisoning, 20 cases occurred as children rode in the back of pickup trucks. In 17 of these, the children were riding under a rigid closed canopy on the rear of the truck, while three episodes occurred as children rode beneath a tarpaulin. Average carboxyhemoglobin level on emergency department presentation was 18.2% ± 2.4% (mean ± SEM; range, 1.6% to 37.0%). Loss of consciousness occurred in 15 of the 20 children. One child died of cerebral edema, one had permanent neurologic deficits, and 18 had no recognizable sequelae related to the episode. In all cases, the truck exhaust system had a previously known leak or a tail pipe that exited at the rear rather than at the side of the pickup truck.

Conclusions.—Carbon monoxide poisoning is a significant hazard for children who ride in the back of pickup trucks. If possible, this practice should be avoided.

INJURIES commonly occur while children ride in the back of pickup trucks, but published reports typically are limited to musculoskeletal trauma.1 Over the past few years, we have treated several children for carbon monoxide poisoning sustained while they were passengers in the back of pickup trucks.

Carbon monoxide intoxication is common in the United States, with an estimated 30,000 persons seeking medical attention or missing at least 1 day of normal activity because of the syndrome each year.2 Approximately 3,200 individuals die annually from carbon monoxide poisoning,3 making it the most common cause of death from poisoning.

Internal combustion engines account for 75% of the carbon monoxide generated by human activities,4 with automobile engines being the most prolific. Emission standards for automobiles vary by state, but carbon monoxide levels as high as 8% (80,000 ppm) are permitted.5 Compare this with the maximal safe level for instantaneous carbon monoxide exposure in the workplace of 200 ppm.6 Exposure to motor vehicle exhaust, even when substantially diluted, thus has significant potential to cause human injury. Unfortunately, such exposure may occur accidentally because individuals are unaware of the risk posed by certain activities.

Methods

Records of patients treated for severe carbon monoxide poisoning in the Hyperbaric Department of Virginia Mason Medical Center, Seattle, Wash, from 1986 to 1991 were reviewed retrospectively. Pediatric patients were defined as individuals younger than 18 years of age at the time of treatment. When identified, charts of pediatric patients were reviewed for the cause of carbon monoxide exposure. All poisonings that occurred while the individuals were passengers in the back of pickup trucks were selected for this report. Information was collected from emergency department records and interviews at the time of hyperbaric treatment (department records). All patients and/or their parents were subsequently interviewed by telephone to obtain missing data and to determine long-term outcome.

Carboxyhemoglobin levels reported represent those values measured during initial emergency department evaluation. Initial evaluation was sometimes performed at an emergency facility other than our institution. Prior to obtaining blood samples for carboxyhemoglobin determination, all patients had been removed from the source of carbon monoxide exposure, and many were treated with supplemental oxygen during emergency transfer from the accident site.

Symptoms described in individual
cases are those recorded during initial evaluation and treatment, as well as those recalled by the patient during fol-
low-up interviews. They typically were symp-
toms spontaneously volunteered by the patient and were not collected by use of a standard questionnaire.

Patients were treated with hyperbaric oxygen in a multiplace hyperbaric cham-
ber. When more than one individual was poisoned in the same incident, the pa-
tients were treated simultaneously.

Treatment consisted of hyperbaric ox-

en administration at 2.5 atmospheres of absolute pressure for 46 to 92 min-
utes. In four cases, additional oxygen was also administered at 1.9 atmos-
pheres of absolute pressure. Treatment duration was based on the severity of initial clinical presentation.

Results

Sixty-eight pediatric patients were treated for accidental carbon monoxide poi-
noning at our facility during the 6-year period examined. Of those, 20 cases oc-
curred as children rode in the back of pickup trucks. In 11 episodes, children were riding situa-

rised closed canopy on the rear of the pickup. In the re-

main ing three episodes, children rode beneath a tarpaulin. Carbon monoxide exposures were frequently grouped, and eight separate incidents were respon-
sible for the 20 cases.

Loss of consciousness occurred at least transiently in 15 patients. Individual data for children with and without loss of consciousness are presented in Ta-
ble i and 2, respectively. Carboxy-

hemoglobin levels for all patients ranged from 1.6% to 37.6%, averaging 18.2% to 2.4% (mean ± SD). These levels did not differ significantly between the group with loss of consciousness (range, 4.6% to 37.6%; mean, 16.7% ± 2.9%) and the group without loss of consciousness (range, 11.1% to 37.6%; mean, 22.9% ± 4.2%). Patient ages in the two groups were also similar. In addition to loss of consciousness, symptoms included headache (10 patients), lightheadedness (nine), nausea (five), dizziness (four), combative-

ness (four), confusion (three), blurred vision (two), ataxia (two), conjunctival injection (one), somnolence (one), diz-

ziness (one), and weakness (one). These symptoms did not correlate with either carboxyhemoglobin level or his-
tory of loss of consciousness.

In one incident involving four chil-
dren, two were dead when discovered. They were not referred for hyperbaric treatment and are not, therefore, in-
cuded in this third child.

The incident that in this died of cerebral edema

Table 1 — Case Characteristics in Group With Loss of Consciousness

<table>
<thead>
<tr>
<th>Age y</th>
<th>Sex</th>
<th>Duration of Exposure, min</th>
<th>COHb, %</th>
<th>Other Symptoms or Signs</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 M</td>
<td>10</td>
<td>19.6</td>
<td></td>
<td>Lethargy</td>
<td>Normal</td>
</tr>
<tr>
<td>7 F</td>
<td>10</td>
<td>21.1</td>
<td></td>
<td>Lethargy, headache, dizziness, nausea</td>
<td>Normal</td>
</tr>
<tr>
<td>10 M</td>
<td>45</td>
<td>15.9</td>
<td></td>
<td>Meningitis, dizziness, nausea</td>
<td>Normal</td>
</tr>
<tr>
<td>4 M</td>
<td>48</td>
<td>11.2</td>
<td></td>
<td>None</td>
<td>Normal</td>
</tr>
<tr>
<td>5 M</td>
<td>60</td>
<td>13.1</td>
<td></td>
<td>Headache</td>
<td>Normal</td>
</tr>
<tr>
<td>13 M</td>
<td>45</td>
<td>35.8</td>
<td></td>
<td>Nausea, dizziness, headache</td>
<td>Normal</td>
</tr>
<tr>
<td>16 F</td>
<td>45</td>
<td>26.5</td>
<td></td>
<td>Headache, confusion</td>
<td>Normal</td>
</tr>
<tr>
<td>12 F</td>
<td>45</td>
<td>26.7</td>
<td></td>
<td>Headache, confusion, dizziness</td>
<td>Normal</td>
</tr>
<tr>
<td>2 M</td>
<td>120</td>
<td>15.9</td>
<td></td>
<td>Nausea, dizziness, headache</td>
<td>Normal</td>
</tr>
<tr>
<td>7 F</td>
<td>25</td>
<td>2.5</td>
<td></td>
<td>Nausea, headache</td>
<td>Normal</td>
</tr>
<tr>
<td>5 M</td>
<td>20</td>
<td>1.6</td>
<td></td>
<td>None</td>
<td>Normal</td>
</tr>
<tr>
<td>1 F</td>
<td>190</td>
<td>5.0</td>
<td></td>
<td>Lethargy, confusion, dizziness</td>
<td>Death by central nervous system</td>
</tr>
<tr>
<td>1 F</td>
<td>190</td>
<td>5.8</td>
<td></td>
<td>Lethargy, confusion, dizziness</td>
<td>Memory deficits</td>
</tr>
</tbody>
</table>

*COHb indicates carboxyhemoglobin.

Table 2 — Case Characteristics in Group Without Loss of Consciousness

<table>
<thead>
<tr>
<th>Age y</th>
<th>Sex</th>
<th>Duration of Exposure, min</th>
<th>COHb, %</th>
<th>Other Symptoms or Signs</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 F</td>
<td>10</td>
<td>15.1</td>
<td></td>
<td>Lethargy, headache, dizziness, nausea</td>
<td>Normal</td>
</tr>
<tr>
<td>6 F</td>
<td>10</td>
<td>15.6</td>
<td></td>
<td>Headache, dizziness, nausea</td>
<td>Normal</td>
</tr>
<tr>
<td>10 M</td>
<td>60</td>
<td>7.7</td>
<td></td>
<td>Lethargy, headache, dizziness</td>
<td>Normal</td>
</tr>
<tr>
<td>13 F</td>
<td>45</td>
<td>29.1</td>
<td></td>
<td>Headache, confusion, dizziness</td>
<td>Normal</td>
</tr>
<tr>
<td>8 M</td>
<td>55</td>
<td>37.0</td>
<td></td>
<td>Somnolence, nausea, dizziness</td>
<td>Normal</td>
</tr>
</tbody>
</table>

*COHb indicates carboxyhemoglobin.

Comment

The cases discussed demonstrate the potential risk of carbon monoxide poi-
noning in children who travel as pas-

cengers in the back of pickup trucks. Ca-

rbon monoxide poisoning in school busses with dusty exhaust or ventilation systems has been reported; however, ascertainment of this hazard with travel in the rear of pickup trucks has not been previ-
ously described. The rate of inci-

dence of this problem is unknown, but it is likely that additional cases of both similar and less-severe exposure in the Seattle region during the same period. These cases have been referred to our facility for treatment because of the lack of need for hyperbaric oxygen treatment or failure to recognize the syndrome. Typical symptoms experienced by the children in this study (such as dizziness, nausea, and headache) may be attributed by par-
ents to retnaxia, sickness, viral illness, or other causes. In fact, many of the par-
ents of these patients initially believed their children to be sleeping in the back of the pickup truck when in fact they were unconscious due to carbon monoxide intoxication.

Mesial assistance for carbon monoxide poi-
noning by physicians is well described.

The syndrome may not be suspected in

Within 48 hours, despite hyperbaric ox-

ygen treatment. The fourth sibling was also treated, but manifested residual neu-

ronal injury, primarily in deficits of cogni-
tion. Data regarding the latter two children are included in Table 1. The remain-
ing 18 children in this series were described by their parents as normal at follow-
up interviews ranging from 6 months to 55 months after treatment. Parents noted no recognizable sequelae related to the episode, reporting that all were exhibiting normal social development and progressive mental growth. Neu-

ropsychiatric testing was not performed on these children.

In the six cases for which information was available, the pickup trucks were typically older model vehicles, ranging from 8 to 18 years of age. Children were riding under canopies in seven of the eight incidents. Canopy windows and doors were closed in all seven instances. In every case, vehicle exhaust systems existed as the side of the pickup and had a known leak (three vehicles), or existed from the rear of the pickup without a recognized leak (two vehicles). No in-

stances occurred which were caused by a pipe that existed from the side of the pickup and had no recognized exhaust leak.

Carbon monoxide poisoning poses a serious threat to children who travel as pas-

cengers in the back of pickup trucks. It is a potentially preventable problem, and car-

bon monoxide poisoning should be recog-

nized by physicians as a potentially life-

threatening emergency.

JAMA, January 22, 1992—Vol 267, No 4

Carbon Monoxide Poisoning in Pickup Trucks—Hammon & Nokolos 539
patients arriving in emergency departments with flu-like illnesses. If universal screening of patients in emergency departments is performed, 5% to 5% of all patients are found to have elevated carbon monoxide levels. Among patients ultimately found to have significant carbon monoxide poisoning, up to 30% may carry an erroneous initial diagnosis. Such reports underscore the strong possibility that other children have experienced carbon monoxide poisoning in incidents similar to those described, yet the syndrome may have gone undiagnosed or unreported.

Carbon monoxide intoxication can cause injury to hypoxic-sensitive tissues such as the brain and the heart, resulting in permanent damage or death. Delayed neurologic deterioration following significant carbon monoxide exposure may also occur after a brief interval ranging from 2 days to 6 weeks, emphasizing the importance of long-term follow-up when attempting to study the effects of carbon monoxide poisoning. The 20 children in this study were all treated with hyperbaric oxygen. The use of hyperbaric oxygen is generally recommended in cases of carbon monoxide poisoning when patients have (1) a carboxyhemoglobin level of 20% or greater, (2) anginal pain or ischemic changes on an electrocardiogram, or (3) any degree of neurologic impairment, regardless of the carboxyhemoglobin level, including transient loss of consciousness. These are the criteria that were used in the current study for selecting patients for hyperbaric treatment in our series. It is possible that patients may meet none of these criteria and still have significant carbon monoxide intoxication. The absence of indicators for hyperbaric oxygen treatment remains controversial.

References