Carbon Monoxide Poisoning From Indoor Burning of Charcoal Briquets

Neil B. Hampson, MD; Christine C. Kramer; Richard G. Dunford, MS; Diane M. Norko, RN, MN

Objective.—To describe the case characteristics of a series of patients poisoned with carbon monoxide (CO) resulting from indoor burning of charcoal briquets.

Design.—Cases of unintentional CO poisoning referred for treatment with hyperbaric oxygen were reviewed. Cases that occurred as the result of indoor burning of charcoal briquets were analyzed.

Setting.—A private, urban, tertiary care center.

Patients.—Seventy-nine patients ranging from 3 months to 87 years of age referred from 10 counties within the state of Washington between October 1982 and October 1993.

Results.—Of 509 patients treated for acute unintentional CO poisoning, 79 cases occurred as incidents of indoor burning of charcoal briquets, for the purpose of either home heating or cooking. A majority of cases occurred in the months of October through January, commonly during power outages or when electricity was intentionally disconnected. Patients of minority races were disproportionately represented compared with the general population of the region.

Conclusions.—Carbon monoxide poisoning is a significant hazard from indoor use of charcoal briquets. All cases are avoidable and public awareness of the risk should be enhanced.

CARBON monoxide (CO) intoxication can cause injury to hypoxia-sensitive tissues such as the brain and the heart, resulting in permanent damage or death. In addition, delayed neurologic deterioration following significant CO exposure may also occur after a latent interval ranging from 2 days to 6 weeks. The death rate from unintentional CO poisoning declined in the United States during the 1980s, due in part to public education and enhanced awareness of activities associated with this risk. Nonetheless, CO intoxication remains common in this country with an estimated 10,000 persons seeking medical attention or missing at least 1 day of normal activity because of the syndrome annually. In addition, 800 to 1000 deaths occur each year making it the most common cause of unintentional poisoning death in the United States.1

Many cases of CO poisoning result from activities not recognized to be hazardous by the victim.2 Because charcoal briquets appear visually to burn cleanly, individuals are often unaware that they emit significant quantities of CO. Cases of CO exposure from indoor burning of charcoal briquets have been reported, but no previous study has described this number of patients, their epidemiology, and reasons for indoor charcoal briquet use.

Methods

Records of patients treated for CO poisoning in the Hyperbaric Department of Virginia Mason Medical Center in Seattle, Wash, from October 1982 to October 1993 were reviewed. A case of CO poisoning was defined as an individual with a history of CO exposure, symptoms consistent with CO intoxication, and an elevated blood carboxyhemoglobin (COHb) level.1 To receive hyperbaric oxygen treatment, patients were required to demonstrate significant CO intoxication, manifested by a COHb level of 25% or greater; arterial pO2 on electrocardiogram, or CO neurologic impairment, including transient loss of consciousness.

Unintentional CO poisonings that occurred as a result of indoor burning of charcoal briquets were selected for this report. Information on individual cases was collected from emergency department and hyperbaric department records. Carboxyhemoglobin levels reported represent those values measured during initial emergency department evaluation, sometimes at a facility outside our institution. Prior to obtaining blood samples for COHb determination, all patients had been removed from the source of CO exposure and many received supplemental oxygen during transfer. Patients were treated with hyperbaric oxygen in a multipurpose hyperbaric chamber. Treatment consisted of hyperbaric oxygen administration at 2.5 to 8.0 atmospheres absolute pressure. Duration of treatment was based on the severity of clinical presentation. Additional standard medical care was provided as appropriate.

Results

During the time reviewed, 509 patients were treated on an emergency basis for acute unintentional CO poisoning. Of these, 79 (16%) were exposed to CO originating from the indoor burning of charcoal briquets in a total of 32 separate incidents. More than one individual was poisoned in 69% of incidents (Table 1). Poisonings demonstrated a seasonal distribution with 24 incidents (75%) occurring during the 4-month period from October through January. Patient ages ranged from 3 months to 87 years (median age, 29 years). Males (48%) and females (52%) were distributed equally with equal frequency. Racial and ethnic minorities accounted for 58 (79%) of the total patients (Table 2). While all black and non-Hispanic white patients spoke English, 21 (88%) of 24 Hispanic white patients and 12 (60%) of 20 Asian patients did not.

Carboxyhemoglobin levels for all patients ranged from 3.0% to 45.8%, averaging 21.6% ± 9.6% (mean ± SD). Loss of consciousness occurred at least transiently in 26 (33%) of the patients. Other symptoms occurring in more than 25% of patients were headache (87%), nausea (54%), vomiting (56%), and dizziness (27%). Less frequent symptoms included lethargy, abdominal pain, confusion, weakness, dyspnea, chest pain, ataxia, seizures, euphoria, irritability, and incontinence.

With regard to circumstances of exposure, the activity associated with indoor charcoal burning was home heating in 16 incidents and cooking in 16 incidents. Loss of consciousness occurred with equal frequency in each type of exposure. The reason for indoor use of charcoal briquets was reported from the Department of Medicine (D Hampson and the Hyperbaric Department [B Hampson, M Kramer, and Norko, and B Dunford], Virginia Mason Medical Center, Seattle, Wash)

From the Department of Medicine (D Hampson and the Hyperbaric Department [B Hampson, M Kramer, and Norko, and B Dunford], Virginia Mason Medical Center, Seattle, Wash)

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Table 2—Race/Ethnicity of Patients With Carbon Monoxide Poisoning Due to Indoor Burning of Charcoal Briquets, Compared With Race/Ethnicity of General Population of Counties of Occurrence 1

<table>
<thead>
<tr>
<th>Race/Ethnicity</th>
<th>No. of Patients (%) of Total</th>
<th>Census (%)</th>
<th>Regional C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asian</td>
<td>29 (38%)</td>
<td>5.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Non-Hispanic white</td>
<td>21 (27%)</td>
<td>85.0</td>
<td>12.2</td>
</tr>
<tr>
<td>Black</td>
<td>3 (4%)</td>
<td>3.6</td>
<td>9.1</td>
</tr>
<tr>
<td>Other</td>
<td>6 (8%)</td>
<td>11.0</td>
<td>6.2</td>
</tr>
</tbody>
</table>

1 Data from 1980 United States Census.

CO, with 75% of grills emitting 200 ppm and above. 2

Carbon monoxide poisoning due to indoor burning of charcoal is common in Korea where over 20% of households use briquets for home heating and cooking. 3

Minority race patients comprised 75% of the patients seen in the present series, disproportionate to the racial and ethnic composition of the counties from which these patients were referred. This suggests that social and economic factors contributed to indoor charcoal use as briquets have also been noted that patients were of minority race and/or non-English speaking. 3,

"Many of our minority patients were first-generation immigrants, continuing to practice their customs with- out awareness of the risk of such activities. While socioeconomic status of patients was not analyzed, the possibility that minority race was a marker for lower socioeconomic status should be considered.

It should be emphasized that manufacturers of charcoal briquets do not intend for indoor use. A standard warning is prominently printed on all packages of briquets produced for domestic use that reads, "Warning—Do not use for indoor heating or cooking unless ventilation is provided for exhausting fumes to outside. Toxic fumes may accumulate and cause death."

Despite this warning, which has been required since 1971, CO intoxication from indoor burning of charcoal briquets continues to occur. In the present study, many patients did not speak English, probably contributing to their disproportionate representation.

The incidence of this problem is unknown, but it is likely that additional cases of similar or lesser severity occurred during the same time period and were not reported for treatment, owing to either lack of need for hyperbaric oxygen or failure to recognize the syndrome. Typical symptoms experienced by patients can easily be attributed to other causes by both physi- cians and patients. Misdetection of CO poisoning by physicians is well described. 3

Many of the patients in our series who burned charcoal indoors for cooking initially suspected food poisoning.

Charcoal briquets are frequently burned in Korean homes when electrical personal comfort heaters are not used, burning a charcoal-based charcoal briquet to the house was disrupted, due either to regional power outages from storms or to intentional malfunction by the utilities company for unpaid bills. The risk of CO poisoning from indoor charcoal briquets is widespread, and the media at times of power outages. In addition, inclusion of a warning with notification of intent to disconnect electrical service by the utility company seems reasonable.

In addition to public warnings due to loss of electrical power, improved public education is needed. This is especially true for minority populations, as they appear at increased risk. The warning printed on bags of charcoal briquets is currently being reviewed by the US Consumer Product Safety Commission for possible clarifi- cation and revision. Such revision must take into account data pertaining to the effectiveness of warnings or poisonings by charcoal briquets do not speak English. Possible solutions would include multilingual warnings or the in- duction of a nonverbal graphic warning.

References


Note: The exact number of patients is 115, which is the sum of the patients found in the 17 incidents. Loss of electrical power in the house was commonly identified, due to a local power outage (storms and the like) in 11 incidents and resulting from intentional disconnection of service by the utility company in two incidents.

Comment

These cases demonstrate that individuals who burn charcoal briquets indoors are at risk for CO poisoning. Previous reports of similar cases have described small numbers of patients, possibly leading to the conclusion that such activity is uncommon, or have reported cases from reviews of death reports, allowing only speculation as to the reasons for indoor charcoal usage. 3

This study reports the largest series of patients poisoned in this fashion and examines reasons for indoor charcoal briquet use, as well as potential risk factors for this activity.

The use of charcoal grills is popular in the United States, although the frequency of indoor use is unknown. According to the Barbecue Industry Association, 44 million American household owned a charcoal grill in 1990. It is estimated that 600 million charcoal-burning events are performed annually, consuming approximately 250,000 tons of charcoal.

Despite the fact that charcoal grills appear extremely safe when burned clearly, overuse and improper handling of the charcoal grills produce significant amounts of CO. The Occupational Safety and Health Administration defines the maximum safe level for instantaneous CO exposure in the workplace as 20 ppm. 3

The air stream from charcoal grills has been shown to contain 28 to 2000 ppm of CO, with 75% of grills emitting 200 ppm and above. 3

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