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Brief Report

Residential carbon monoxide poisoning from motor vehicles[☆]

Neil B. Hampson MD*

Department of Medicine, Virginia Mason Medical Center, Seattle, WA 98101, USA

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Abstract

Context: Although morbidity and mortality from accidental carbon monoxide (CO) poisoning are high in the United States, identification of common but poorly recognized sources should help prevention efforts.

Objective: The study aimed to describe CO poisoning of home occupants due to a vehicle left running in an attached garage.

Design: News stories reporting incidents of US CO poisoning were collected daily from March 2007 to September 2009 via a news.Google.com search and data extracted.

Patients: Patients were individuals reported in the media to have been poisoned with CO in their home by a vehicle running in the attached garage.

Main Outcome Measures: Main outcome measures were frequency of occurrence, geographic distribution, patient demographics, and mortality.

Results: Of 837 CO poisoning incidents reported in US news media over 2 and a half years, 59 (8%) were the result of a vehicle left running in the garage. The elderly were disproportionately affected, with incidents most common in states with larger elderly populations and 29% of cases with age specified occurring in individuals older than 80 years. Among those older than 80 years, 15 of 17 were found dead at the scene.

Conclusions: Residential CO poisoning from a vehicle running in the garage is common, disproportionately affects the elderly, has a high mortality rate, and should be preventable with a residential CO alarm.

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1. Introduction

Carbon monoxide (CO) poisoning is common in the United States, accounting for an estimated 50 000 emergency department visits and approximately 2700 fatalities annually

[1,2]. It is generally believed that most accidental CO poisoning is preventable through the use of public education programs, application of government regulations limiting CO production, and both industrial and residential use of CO alarms.

Effective public education programs first require the identification of relatively common yet poorly recognized sources of CO poisoning that are responsible for significant morbidity and/or mortality. This report describes one such source, motor vehicles left running in the garage of an attached home. Although the associated risk may seem obvious, reported incidents are not only common but are associated with an extremely high mortality rate.

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* Tel.: +1 206 583 6543.

E-mail address: neil.hampson@vmc.org.

It is the purpose of this article to describe the syndrome of residential CO poisoning from automobiles left running in the garage and make recommendations for prevention.

2. Materials and methods

Data were gathered from news stories about CO poisoning in the United States from March 2007 through September 2009. A daily news search was established on news.Google.com, in which print and electronic news media were searched for stories containing the phrase “carbon monoxide poisoning” [3]. The list of news stories and each associated URL was emailed automatically on a daily basis to the author. All stories were reviewed and data were extracted from reported US poisoning incidents including the state in which poisoning occurred, number and age of patients, location of poisoning and source of CO, number of deaths, and presence or absence of a CO alarm. Not every news story contained all items of data listed.

The present study selected for analysis the subset of those news stories that described accidental CO poisoning occurring in a residence (home, condominium, apartment) with the source of CO reported as a motor vehicle left running in an attached garage. Statistical analysis included descriptive statistics and χ^2 test.

3. Results

During the 30-month period described, a total of 837 different CO poisoning incidents were reported in US news stories, as identified by the news.Google.com search. These involved a total of 4365 CO-poisoned individuals. Of these incidents, 59 (8%) resulted from leaving a motor vehicle running in a garage with resultant poisoning of the occupants within the attached residence.

Poisoning incidents occurred in 28 different states. States with more than one incident included Florida (10), Pennsylvania (9), Ohio (5), Texas (4), Connecticut (3), Colorado (2), Massachusetts (2), Nebraska (2), North Carolina (2), and Washington (2). The type of residence was described as a house or home in 52 incidents, condominium in 5, and apartment in 2.

A total of 175 individuals were poisoned in the 59 incidents (range, 1-12 per incident) (3 ± 2 , mean \pm SD). Most of the incidents (83%) resulted in more than one individual poisoned. Those poisoned were described as adults (age ≥ 18 years) in 154 cases and children in 21 cases. Specific ages were provided in the news stories for 38 individuals, ranging from 1-92 years (mean, 57 ± 32 years), with age implied (“girl,” “teen”) in 21 others. Of the 59 total, 17 (29%) were older than 80 years.

When described, the motor vehicle was left running in the garage by a teenager, a 36-year-old woman, a “father,” a “mother” on 2 occasions, a 77 year-old woman who “suffered from memory loss or dementia,” an “elderly female,” an 81-year-old man, and a 91-year-old woman. In 2 cases, cars were intentionally left running to charge the battery.

All incidents occurred in situations where garages were attached to the residence. In one case, the door from the garage to the home was noted to have been left open and in another case to have been closed. In 2 condominium incidents, CO was said to have entered and poisoned individuals in multiple units. Carbon monoxide alarms were reported to have been absent in 2 incidents and present in 1, in which case it alarmed and alerted the occupants to the hazard. In one incident, an elderly couple who did not have a CO alarm had fatal poisoning despite the fact that they had previously been hospitalized for CO poisoning from exactly the same mechanism.

Sixty-three (32%) of the total 175 poisoned individuals died. This mortality rate is significantly higher than the 502 deaths (12%), which resulted from the 4190 poisonings reported from causes other than home/garage exposure ($P < .001$). Of the 17 individuals reported to be older than 80 years, 15 were found dead at the scene.

4. Discussion

In this study, it is demonstrated that household CO poisoning from a motor vehicle left running in the garage is relatively common. Engines were sometimes left running intentionally but usually accidentally. From these reports and clinical experience, the reasons for intentionally running the engine in the garage include (1) charging the vehicle’s battery, (2) warming the vehicle before going out into cold weather, or (3) providing power to a radio or other music device.

Reasons for accidentally leaving the engine running could include (1) distraction or forgetfulness when leaving the vehicle, (2) intoxication with drugs or alcohol, (3) impaired hearing, or (3) some form of dementia. It is interesting to note that in a number of the news stories, the individual involved was described as being “elderly” and, in one, as having “forgetfulness or dementia.” If these are common reasons, one would expect that the total population poisoned in this fashion should be older than a general population of CO-poisoned individuals.

The current population averaged 57 years of age, whereas those in a recent article describing 1407 consecutive patients treated for CO poisoning at one hyperbaric facility averaged 35 ± 19 years [4]. The current population is even more striking for the number of octo- and nonagenarians seen. Nearly one half of those for whom exact age was specified in the news stories was older than 80 years, in contrast to 2% in that larger population of CO-poisoned patients.

This age predominance of home CO poisoning from a running vehicle in the garage is supported by the observation that the 4 states with the most incidents rank among the top 6 states for number of inhabitants older than 65 years [5].

This appears to be an instance where the elderly are at greater risk for CO exposure and also have a lower chance for survival than younger individuals similarly exposed. The exposure risk likely relates to age-related cognitive changes leading to forgetfulness and lack of awareness that they have left the vehicle running. Reduced ability to hear the engine running may play a role as well. The high mortality rate may be due to physical inability to escape the environment once they start to become ill or greater susceptibility to poisoning resulting from comorbid conditions.

It is possible to imagine elaborate engineering solutions to solve this problem. For example, cars' engines could be programmed to automatically turn off after they have idled for a predetermined period or after a few minutes when no passengers are sensed in the vehicle. Carbon monoxide sensors could be installed that would shut off the engine at a specified ambient CO level.

Alternatively, simple solutions are available. If a family member is elderly and still driving, a hook could be installed just inside the door from the garage, upon which they should hang their car keys when entering. Although this still depends on the individual to remember to perform the action, the visual cue may be helpful.

Most effective should be installation of a CO alarm in the home. In the one instance where a CO alarm was present, it alerted the occupants to the danger and they escaped before significant poisoning occurred. There is a movement in the United States for states to pass legislation requiring residential CO alarms [6]. Unfortunately, many of these laws exclude homes without fuel-burning appliances. An attached garage needs to be considered an independent risk factor for poisoning even in an all-electric home. Furthermore, because CO may permeate throughout condominiums and apartments from a single source, the garage does not need to be directly adjacent to the living space for poisoning to occur [7].

This study reinforces the concept that media reports such as news clipping services and Internet searches can provide useful sources of medical research data for conditions with high media visibility such as CO poisoning [8,9]. With the widespread availability of access to the Internet and its comprehensive reporting capabilities, additional studies based on this method will undoubtedly be seen in the

future. Limitations to the method include the fact that data reported in a news story may be incomplete with regard to specific data variables sought and the fact that news reports tend to be published as soon as possible, increasing the likelihood for misinformation.

In summary, this report shows that residential CO poisoning from a running vehicle in an attached garage is common, associated with high mortality, and appears to disproportionately affect the elderly. The most appropriate solution appears to be mandated use of residential CO alarms, along with recognition by those writing such legislation that an attached garage is a risk factor for CO exposure.

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