Original Article

Fatal carbon monoxide poisoning: A lesson from a retrospective study at All India Institute of Medical Sciences, New Delhi

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Abstract

Background: Carbon monoxide (CO) is a colorless, odorless, tasteless, and nonirritating gas which makes it difficult for those who are exposed, to detect it, leading to unexpected death. This study was undertaken to see the pattern of fatal CO poisoning and to discuss preventive aspect. **Materials and Methods:** It was a retrospective descriptive study of fatal CO cases which were autopsied at All India Institute of Medical Sciences, New Delhi, from the year 2010 to the year 2015. The cases were analyzed as per age groups, circumstances of death, season of death, and sources of CO formation. **Results and Discussion:** The study involved 40 cases of fatal CO poisoning. About 80% of cases were reported in winter months. The maximum cases were reported in the month of January followed by November and December. All the cases except one, died with a source of CO nearby and the person was inside a room or some closed space without ventilation. Source of CO was firepot and electric room heater in most of the cases. Some cases were of CO build inside the car with a running engine. Most of the cases occurred accidentally. **Conclusion:** Clustering of cases is seen in winters. Poisoning can occur in different ways. The study documents the various possibilities of CO poisoning and advocates community education targeting the high-risk groups and masses, especially during the winter season.

Keywords: Carbon monoxide alarm, closed space, firepot, room heater, ventilation, winter season

Introduction

Carbon monoxide (CO), which is one of the many ubiquitous contaminants of our environment, is responsible for a large percentage of the accidental poisonings and deaths reported throughout the world each year. CO is a colorless, odorless, tasteless, and nonirritating gas, which makes it difficult for those who are exposed to detect it. Because CO lacks sensory warning properties, it is commonly known as the "silent killer."[1] CO is formed during an incomplete combustion of organic material, for example, gasoline, coal, wood, propane, and natural gas. Common workplace sources of CO include fuel-powered engines (motor vehicles, forklifts, generators, pumps, etc.), fuel-burning heaters (furnaces, water heaters, boilers, space heaters, etc.), coke ovens, and blast furnaces. However, the most common sources of CO are faulty, poorly maintained, or inadequately ventilated gas appliances such as stoves and heaters.[2] Malfunctioning heating systems, improperly ventilated motor vehicles, generators, grills, stoves, and residential fires may be listed in the common sources of CO exposure.[3,4]

CO has 210 times the affinity for hemoglobin than that of oxygen and impairs oxygen delivery and peripheral utilization leading to cellular hypoxia.[2] It can result in a variety of acute symptoms in low doses, including headache, dizziness, weakness, nausea, confusion, disorientation, and visual disturbances. In extreme

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cases, exposure leads to unconsciousness, coma, convulsions, and even death.[5,6]

Few studies on CO poisoning and only a few cases of fatal CO poisoning with different scenarios have been reported from India, but no article has shed light on the preventive aspect of it.[7-11] Considering the public health importance of the CO poisoning and the knowledge gap, this study has been conducted to study the epidemiological profile and circumstances of fatal CO poisoning cases from the South Delhi region for the year 2010–2015. The article also explores the preventive aspect of it.

Materials and Methods

This was a retrospective descriptive study of fatal CO poisoning cases which were autopsied at All India Institute of Medical Sciences, New Delhi, from the year 2010 to the year 2015. Only those cases were included in this study in which death was opined due to CO poisoning, based on characteristics autopsy findings, toxicology report from forensic science laboratory, and crime scene investigation report, and after ruling out other causes of death. The cases were analyzed as per age groups, circumstances of death, season of death, and sources of CO. These factors were especially studied to determine the pattern in collection of CO in the deceased's environment and to find out a way to prevent these incidents.

Results

The study involved 33 incidences of CO poisoning with 40 victims reported at All India Institute of Medical Sciences, New Delhi. All the cases were brought dead to the casualty of the institute.

Out of them, 35 were males and 5 were females. Age of the victims was varying from 8 to 59 years with maximum number of cases seen in the age group 31–45 years followed by 15–30 years, and all of the cases, except one, were from economically productive age group [Table 1].

Ninety percent of the incidents were reported in winter months, i.e., November, December, January, and February month of the year. Incidents were about equally distributed among November, December, and January month of the year [Table 1]. All the victims, except one, died with a source of CO nearby and the person was inside a room or some closed space without any ventilation. In one case, the deceased person was sleeping in a field inside an impervious mosquito net with a firepot inside, which again created a zone of high CO concentration. Most of the victims were alone at the time of the incident, except in four incidents, there were more than one victim, and in one case, there was a stray dog that also died sleeping in the room with a security guard. Source of CO was firepot in most of the cases. Two scenarios of death were of CO build inside the car with the engine and car blower running. Most of the incidents occurred accidentally, except one where a person used CO cylinder to poison himself, purchasing it online on the pretext of research [Table 2].

Except in four incidents, victims were daily wagers, servants, or security guards who used to sleep in a single room accommodation or in the security booth. Among those four incidents, in one incident, the family was involved with two women, one boy, and one girl, succumbing to CO poisoning when their house burnt. In the second incident, three students were found dead inside a car with running engine. In the third incident, a businessman was found dead inside his car with running engine, and in the fourth incident, a student committed suicide using CO cylinder.

Table 1: Demographic profile of carbon monoxide poisoning

Variable	Subvariable	Number of incidents	Number of victims
Gender	Male	30	35
	Female	3	5
Age group (years)	<15	1	1
	15-30	8	15
	31-45	23	23
	>45	1	1
Month of the year	January	9	10
	February	2	3
	July	2	4
	October	1	4
	November	9	9
	December	10	10
Year	2010	5	5
	2011	8	8
	2012	4	7
	2013	5	6
	2014	5	7
	2015	6	7

Table 2: Circumstances of carbon monoxide poisoning

Variable	Subvariable	Number of incidents	Number of victims
Season of the year	Winter	30	32
	Other seasons	3	8
Place of incident	Car	2	4
	Inside mosquito net	1	1
	Room	24	29
	Security booth	6	6
Source of CO	CO cylinder	1	1
	Electrical room heater	13	14
	Firepot	16	17
	Burnt house	1	4
	Running car engine	2	4
Manner of poisoning	Accidental	32	39
	Suicidal	1	1
Victims involved	Single victim	29	29
	Multiple victims	4	11

CO: Carbon monoxide

Discussion

This study was undertaken to study the pattern and circumstances of CO poisoning death and to discuss its preventive aspect. Patterns of the high number of cases of CO poisoning in the colder months of November to February and a less number of cases in the hotter months of June to August is seen in this study in concordance with other studies.[12,13] Deaths were among economically productive age group and more commonly accidental as in other studies worldwide,[2,11,14-17] but CO has long been recognized as a means of deliberate suicide too,[18-20] as in our study.

Firepots, car engines, and room heaters were sources of CO in this study as well as in other studies.[3,4] Use of room heaters, which is shown to be one of the top sources of CO fatalities, is predominant during the winter season and can release high amounts of CO if the equipment is not functioning properly or the place is not ventilated.[1] In this study too, the rooms in which the deceased were sleeping with the firepots/room heater were having poor ventilation with vents sealed to prevent any cold breeze.

This study along with other case reports from India and worldwide[11-17] showed that the main cause of CO poisoning is accidental collection of CO in a nonventilated room/closed space. Detection of CO collection is difficult for sleeping person because of its "silent" physical and chemical property.[1] People should be alarmed about the danger of CO collection and poisoning in a nonventilated room while using various room warming mechanisms such as firepots and room heater and by putting warning labels on various CO-producing appliances.[21-23] They should be taught to avoid using these appliances without proper ventilation in the area to avoid collection of dangerous CO.[24,25] Alternatively, a CO alarm can be put in the house and closed area, even in cars, while using these appliances[26] and it should be promoted as smoke alarms.[27] This prevention is important because it takes toll among economically productive age groups.

Conclusion

CO poisoning mostly occurs during winter season as evident. There is the use of various room heating mechanisms during this period which leads to the formation of CO gas in closed nonventilated room. Special efforts should be done during this period to educate the masses regarding this silent killer, and various preventive measures should be taken with which morbidity and mortality can be minimized. High-risk groups, such as people living in single room accommodation, using heater, blower, firepot, especially in winters, as found in this study, should be identified and they should be especially warned and educated regarding such risk.

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Conflicts of interest

There are no conflicts of interest.

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