ORIGINAL ARTICLE

Profile of Acute Carbon Monoxide Poisoning in the West Province of Iran

Mitra Yari[1], Nasrin Fouladi[2], Habib Ahmadi[2] and Farid Najafi[3]

ABSTRACT

Objective: To document the epidemiology and risk factors of acute carbon monoxide (CO) poisoning in the west of Iran and specify potentially presentable characteristics.

Study Design: Observational study.

Place and Duration of Study: Imam Khomeini Hospital of Kermanshah, Iran, from July 2006 to March 2008.

Methodology: This study was conducted using the records of 143 cases of CO poisoning referred to the only centre for the reference of poisoning cases. Intent, age groups, source of poisoning and clinical presentation were noted and described as frequency.

Results: One-hundred forty two cases (99.3%), were accidental and only one case (0.7%) was suicidal. Mortality was (21.7%, n=31). The highest mortality was found in the age groups of 20-30 years and below 10 years. The greatest frequency happened in autumn and winter. The clinical symptoms and manifestations of CO poisoning included headache (35.3%), nausea (25.4%), vomiting (21%), dyspnea (10.3%), and decrease in level of consciousness (8%). Gas water heaters (35%), room heaters (32%), stoves (24%) and other items (9%) were the principal sources of the individuals' exposure to CO.

Conclusion: CO poisoning is a serious public health problem in west of Iran (Kermanshah). The number of CO poisoning cases was highest in the colder seasons of the year, whereas the majority of the poisoning cases could be prevented.

Key words: *CO poisoning. Epidemiology. Accidental exposure.*

INTRODUCTION

Poisoning can be defined as an event, in which a material is absorbed via oral ways, respiration, eyes, vein, etc. to the extent that harms the body. Following the absorbance, the symptoms of intoxication appear which may be fatal.[1] Poisoning either intentional or un-intentional has been one of the major problems seen in the emergency departments of the hospitals.[1,2]

CO is an odourless, colourless, and non-irritating gas, produced as the consequence of incomplete combustion of hydrocarbons.[3,4] The acute exposure to the moderate amount of CO displays symptoms such as headache, nausea, vomiting and dizziness, and to the massive amount of it entails cardiopulmonary collapse and death.[5,6] The epidemiologic inspection of CO poisoning is of great prominence which can be utilized for the strategic preventive programming purposes.

CO has been identified as the main source of intentional or un-intentional poisoning and one of the major causes of the fatality followed by poisoning.[7] According to forensic reports, 769 death cases were recognized as the result of this type of poisoning in 2009.[8]

The objective of the current study was to document the pattern of incidence, principal sources, seasonal variation and the consequences of acute CO poisoning in the west of Iran.

METHODOLOGY

The design of the present study was observational type. The records of patients, referred to Imam Hospital of Kermanshah, from July 2006 to March 2008, were examined. This hospital was the only centre for the reference of poisoning cases.

In this study, the necessary information about the patients' age and sex, intentionality or unintentionality, and the time of the poisoning, the sources of exposure, seasonal distribution, and consequences were gained from the files of the patients.

We calculated descriptive statistics such as percentages by case characteristics and used chi-square test for qualitative data to determine differences in case frequency of CO mortality and morbidity with respect to age groups and seasons. The statistical analysis was run using Statistical Package for Social Sciences (SPSS) version 12. Results were presented as percent (%). A p-value of less than 0.05 was considered significant.

Department of Anaesthesiology[1] / Community Medicine[2] / Epidemiology[3], Kermanshah University of Medical Sciences, Iran.

***Correspondence:** Dr. Nasrin Fouladi, Community Medicine Group, Faculty of Medicine, Ardebil University of Medical Sciences, Ardebil, Iran.*
E-mail: n.fouladi@arums.ac.ir

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RESULTS

In conducting this study, 143 patients with CO poisoning were examined. The results showed that 52 cases (36%) of all the cases were male and 91 cases (64%) were female. The ratio of female to male poisoning was 1.7. The proportion of females was more than males in all the age groups. The range of age was between 3 and 86.

The age distribution of poisoning and the death followed by poisoning was analyzed according to the age group of the cases. The greatest amount of poisoning was found in the age group of 20-30 (21.7%). The rate of poisoning morbidity was significantly different between age groups ($p < 0.001$). The number of cases who died in this study were 31 out of 143 cases. Most of poisoning morbidity rate of 73 cases (51%) was seen in the age group of 20 - 30 years. The highest percentage of mortality (n=19, 61.3%) was detected among young and male cases in the same age group. Poisoning mortality and morbidity was significantly different between age groups ($p < 0.001$, Table I).

With respect to seasonal distribution, the poisoning cases revealed 29 cases in spring, 7 cases in summer, 39 cases in autumn, and 68 cases in winter. The morbidity rate from CO poisoning in autumn and winter were significantly higher than other seasons ($p < 0.001$, Table II).

A close look at the number of deaths in different seasons of the year revealed that the number of poisoning death cases in autumn and winter were higher as compared to spring and summer. There were 11 cases (35.5%) in each of the two seasons, i.e. autumn and winter as compared to 8 cases (25.8%) and one case (3.2%) in spring and summer respectively. The rate of poisoning mortality in autumn and winter was significantly higher than other seasons (p=0.034, Table II).

The observation of the frequency of death showed that male, younger age, as well as in cold weather were related to acute poisoning and poisoning deaths.

Table I: Age distribution with regards to morbidity and mortality in cases.

Age group (years)	Morbidity	p-value	Mortality	p-value
0-9	7 (4.9%)		6 (19.3%)	
10-19	29 (20.3%)		3 (9.7%)	
20-29	73 (51%)	< 0.001	19 (61.3%)	< 0.001
30-39	12 (8.4%)		2 (6.4%)	
40-49	10 (7%)		1 (3.2%)	
≥ 50	12 (8.4%)		0 (0%)	

Table II: Seasonal distribution of morbidity and mortality.

Season	Morbidity	p-value	Mortality	p-value
Spring	29 (20.4%)		08 (25.8%)	
Summer	07 (4.9%)	< 0.001	01 (3.2%)	< 0.05
Autumn	39 (27.2%)		11 (35.5%)	
Winter	68 (47.5%)		11 (35.5%)	

In addition, the examination of the poisoning cases showed the highest level of CO poisoning; 84 cases (58.7%) in 2007. During that year 66 cases (78.5%) were observed in autumn and winter and merely 18 cases (21.4%) in spring and summer.

Among all the poisoning cases, the intent in the majority (99.3%) was accidental and only one (0.7%) was suicidal.

The clinical symptoms and manifestations of CO poisoning included headache in 50 cases (35%) and nausea, vomiting in 36 cases (25.2%) each, dyspnea in 14 cases (10%), and reduced level of consciousness in 7 cases (4.8%).

Gas water heaters in 50 cases (35%), heaters in 46 cases (32%), stoves 34 cases (24%) and other sources (n=12, 9%) were the sources of exposure to CO poisoning (Figure 1). Besides, the results exhibited that the water heater was the most frequent source of those poisonings which entailed death.

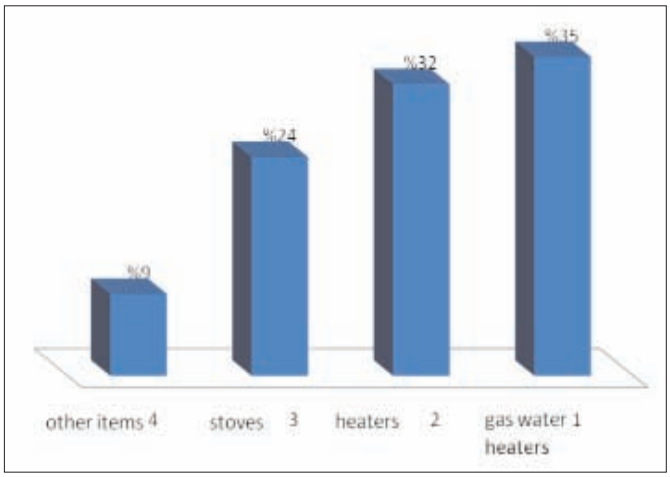

Figure 1: Sources of CO poisoning.

DISCUSSION

The present study manifested a significant difference among CO poisoning cases in terms of gender. The higher percentage of poisoning (64%) was seen in females, which might be due to the location of the poisoning. Most of the poisoning cases happened at home in which females had the responsibility of doing house chores and were more likely to be exposed to the potential poisoning sources. CO poisoning among the age group of 20-30 years was the most frequent. Furthermore, the death toll was also the highest in the same age group as well as in the age group below 10 years. The reason for involvement in this age group can be atributed to their less attention to the preventive measures. The younger age group has an increased exposure to high minute ventilation volume and high metabolic rate.[9,10]

The analysis of the data showed that the number of CO poisoning death among males was more than females,

which complied with the outcomes of prior studies conducted in other countries.[2,11-13] Due to males' lesser engagement in indoor activities, they are more likely to be exposed to higher amount of CO, and consequently acute poisoning. Accordingly, the cause of high CO poisoning mortality in males is probably related to the environment and the source of poisoning.

The outcomes of the current study indicated more frequent incidence of CO poisoning in winter which was consistent with the other studies findings.[14,15] Comparable to the national and foreign countries data, CO poisoning followed a seasonal pattern. In a population-oriented case control study undertaken in Taiwan for the purpose of investigation of risk factors and un-intentional fatality of poisoning, Shie and Li discovered that the ratio of fatality increased in the cold season of the year.[16] A study conducted in Seoul revealed a 9 times increase in CO poisoning in December than that in August.[17] Morbidity and mortality weekly report published by US about disease control and prevention of mortality showed that most of the accidental CO poisonings happened in winter.[18] The results of these reports hold true for the present study outcomes.

This data supported these findings by showing the higher frequency of CO poisoning in autumn and winter compared with spring and summer, in the western part of Iran (Kermanshah). Additionally, the current study revealed that the amount of CO poisoning and mortality caused by poisoning was of higher extent in the winter with lower means of temperature. Employing home heating systems in the enclosed environment led to the increased exposure of the individuals to CO, during the cold seasons of the year.

The findings of the present study emphasized the importance of embarking on and assessing public health awareness programs for decreasing the individuals' exposure to CO prior to and during winter.

Noxious exposures to CO, particularly those happening in homes can be prevented. The main preventive measure should be the proper installation and maintenance of heating systems and installation of CO detectors. These basic measures can reduce the CO exposures noticeably.

Water heater can be referred to as the primary cause of CO poisoning compatible to data obtained from other countries. Majority of the cases related to malfunction of the water heater.[19] The heating systems have not yet achieved the defined standards. Besides proper installation of the heating systems, annual servicing of the gas appliances by registered engineers should be recommended to people.

The present study manifested seasonal pattern of CO poisoning with some principal sources of exposure. For a comprehensive prevention program to be planned for CO poisoning, the above features should be taken into consideration. Certainly the plan should aim those who are at the higher risk of CO poisoning.

Suicidal CO poisoning cases explained only 0.7% of total CO poisoning cases which is consistent with previous findings in other countries.[20] Thus, the current study's data practically reflected the epidemiological features of un-intentional CO poisoning cases in Kermanshah.

CONCLUSION

CO poisoning continues to be a major public health problem in western part of Iran (Kermanshah). The number of CO poisoning cases were high in cold months. The majority of these poisoning cases could be prevented. Applying improved standards in heating systems along with public awareness campaigns may bring about a reduction in the incidence of CO poisoning.

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