International Journal of Forensic Medicine

E-ISSN: 2707-4455
P-ISSN: 2707-4447
IJFM 2020; 2(2): 17-20
Received: 13-05-2020
Accepted: 15-06-2020

Dr. Hind Abouzahir
Forensic Resident Doctor, Medico-legal Institute, Ibn Rochd University Hospital, Casablanca, Morocco

Samir Nya
Assistant Professor of Forensic Medicine, Faculty of Medicine and Pharmacy, Tangier, Morocco

Ahmed Belhouss
Professor of Forensic Medicine, Medico-legal Institute, Ibn Rochd University Hospital, Casablanca, Morocco

Hicham Benyaich
Professor of Higher Education of Forensic Medicine, and Head of Medico-legal Institute, Ibn Rochd University Hospital, Casablanca, Morocco

Corresponding Author:
Dr. Hind Abouzahir
Forensic Resident Doctor, Medico-legal Institute, Ibn Rochd University Hospital, Casablanca, Morocco

Review of deaths cases due to carbon monoxide poisoning in a tertiary hospital

Hind Abouzahir, Samir Nya, Ahmed Belhouss and Hicham Benyaich

DOI: https://doi.org/10.33545/27074447.2020.v2.i2a.27

Abstract
Background: Carbon monoxide threatens its victims with sudden anoxic death and severe neurological sequelae.
Materials and Methods: This is a descriptive and analytical retrospective study on 14 cases of deaths due to Carbon monoxide poisoning collected at the Forensic Department of Ibn Rochd University Hospital in Casablanca (UHC), over a two years period from January 2018 to December 2019.
Results: Among the 14 deaths, there were nine (N=09) male victims (64%) and five (N=05) female (36%), aged 25 to 44 years in 43% of cases and 45 to 64 years in 36% of cases. Vast majority of cases (86%) involved accidental household poisoning. A water heater was incriminated in 36%. The source of Carbon monoxide was related to a defective device (36%). Neurological signs such as disturbances of consciousness were the most common (92%) symptom. The peak poisoning period (50%) occurred in December.
Autopsy revealed pulmonary petechial spots (14%) and congestion of most organs. Carboxyhemoglobin (COHb) was positive in 8 cases with a rate> 5%, including 3 victims with no history of smoking and > 10% among 5 smokers. The value was negative for two victims who received oxygen therapy during hospital resuscitation efforts. The COHb level was indeterminable in 4 cases of which 3 victims were in advanced decomposition and one was exsanguinated.
Conclusion: Prevention is key in reducing the morbidity and mortality of Carbon monoxide poisoning that can cause sudden anoxic death and severe neurological sequelae.

Keywords: carbon monoxide, forensic autopsy, carboxyhemoglobinemia, accidental poisoning

Introduction
Carbon monoxide (CO) is a natural gas present physiologically in the body and in the atmosphere. It has a physiological role for humans at very low concentrations but becomes toxic, potentially fatal, at higher concentrations. It is odorless, invisible, tasteless and non-irritating, which gives it the nickname of "silent killer". Lighter than air, it is volatile and highly diffusible, thus penetrating the body by-passing the capillary alveolar barrier when inhaled. In physiologic amounts endogenous CO acts as a neurotransmitter. At low levels, CO may favorably modulate inflammation, apoptosis, and cell proliferation and also up-regulate mitochondrial biogenesis. At higher levels poisoning results [1].
In Morocco, the causes of poisoning are diverse, often collective, usually domestic and seasonal, more often accidental mode, and essentially in closed places. The diagnosis is sometimes difficult because of its insidious nature, which poses a real public health challenge. This intoxication remains little known to the general population. It is most often neglected or not mentioned by doctors poorly sensitized to this danger.
According to the latest figures from the Poison Control and Pharmaco-vigilance Center of Morocco (CAPM), 2,962 cases of poisoning by gas were recorded in 2016. The offending gases are carbon monoxide in 99.4% of cases (bomb gas), tear gas accounts for 0.4% of cases and butane gas 0.2%. Carbon monoxide poisoning killed 7 people in 2016.
The Center admits this is an underestimation, as deaths at home are not covered by the CAPM reporting system, which is based on notifications from health structure.
From 1991 to 2016, the CAPM noted a steady rise in cases in Morocco [2]. Indeed a report from other climes opined that carbon monoxide poisoning is the most common cause of injury and death from poisoning worldwide [3], most cases however are underreported because non-lethal cases go undetected [4].

The objective of this study is to elucidate the profile of the victim, the circumstances of the poisoning, the autopsy morphological appearances as well as the toxicological findings while providing a review of the literature.

Materials and Methods

This is a descriptive and analytical retrospective study on 14 cases of deaths due to carbon monoxide poisoning collected at the forensic department of Ibn Rochd University Hospital in Casablanca (UHC), over a period from January 2013 to December 2016.

The data were obtained from forensic departmental registers and case records, police reports, victim's medical records and autopsy reports.

Results

Of the 14 deaths, there were nine (9) male victims (64%) and five (5) females (36%), aged 25 to 44 years in 43% of cases and 45 to 64 years in 36% of cases. (This is shown in figure 1). Median age was 42.6 years. A vast majority of cases (86%) were due to accidental household poisoning.

The poisoning occurred mostly in winter with a peak of 50% observed in December. A water heater was incriminated in 36% of cases, followed by a gas cylinder in 29% of cases. In contrast, fire was the source of carbon monoxide in 14% of cases. (This is depicted in Table 1 below). Investigation revealed that the direct actions leading to carbon monoxide poisoning were related to a faulty device (36%), poor use of devices (29%) and lack of ventilation (14%). Others as shown in Table 2. The most common presenting symptoms were neurological signs such as disturbances of consciousness (92%).

The external examination of the corpses revealed varied features including purplish lividity in 14% and cochineal red appearances in 7% of cases. Autopsy revealed pulmonary petechial spots in 14% of cases, cerebral congestion and pulmonary congestion, visceral congestion in 57%, 50% and 43% of cases respectively. Pinkish staining of most organs was observed in 64% of cases. The autopsy was unspecific in 7% of cases. (This is illustrated in Figure 2 below). Toxicological studies yielded carboxyhemoglobinemia (COHb) positivity in 8 cases with a value > 10 % in 3 victims who did not have a history of smoking and a value > 20 % in 5 known chronic smokers. COHb was undetectable in two victims who received oxygen therapy during their stay at the reanimation. The COHb level was equivocal in 4 cases of which 3 victims were in a state of advanced putrefaction, and exsanguinations in the fourth case. Methemoglobin (metHb) was not analyzed in our study.

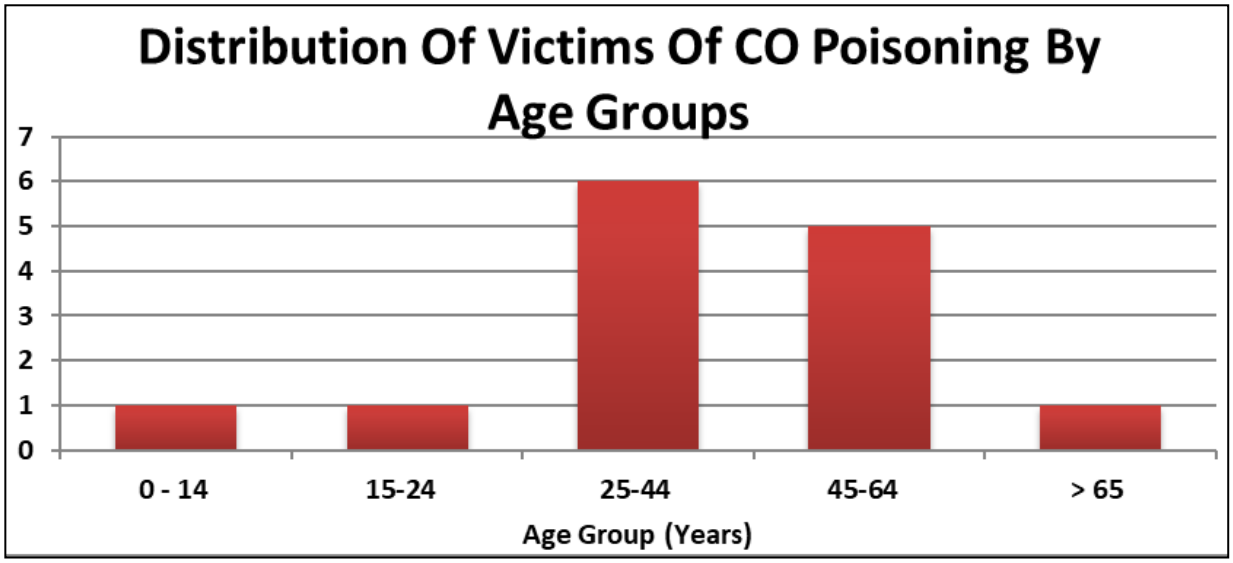

Fig 1: Chart showing the distribution of victims of carbon monoxide poisoning in UHC Ibn Rochd center according to age group

Table 1: Table showing the various sources of CO seen in cases of carbon monoxide poisoning.

Source of CO	Frequency	%
Water heater	5	36%
Gas cylinder	4	29%
Fire	2	14%
Charcoal	2	14%
Brazier	1	7%
TOTAL	14	100%

Table 2: Table showing the direct Actions Leading To CO Poisoning

Circumstances of poisoning	Number of cases	%
Faulty device	5	36%
Poor use of devices	4	14%
Ventilation problem	2	29%
Faulty installation	1	7%
Fire	2	14%
Total	14	100%

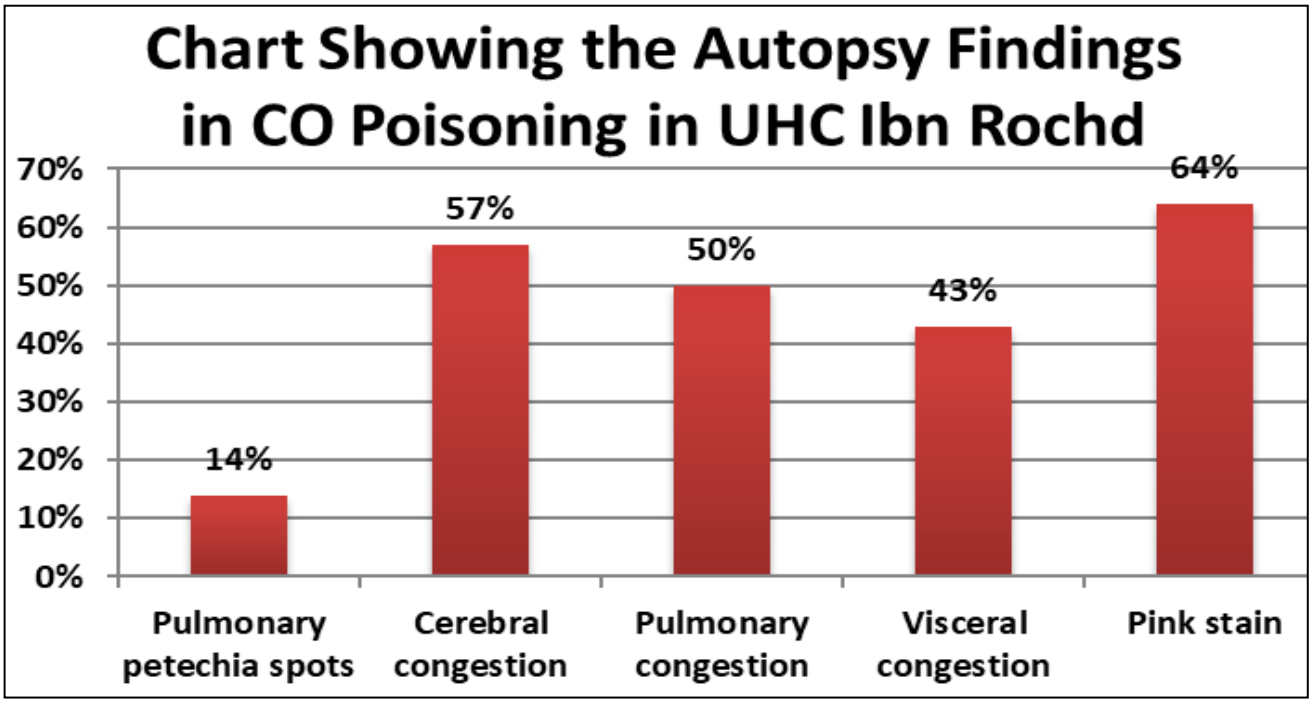

Fig 2: Chart showing the distribution of post mortem morphological changes seen in cases of carbon monoxide poisoning in UHC Ibn Rochd center

Discussion

The data obtained in this study does not represent the general population, but only the cases managed by the forensic doctors of the department of Legal Medicine of the UHC Ibn Rochd, whose intervention is regulated by hospital policy in the circuit of care.

A study [5] reported preponderance of men (54%) of poisoned victims against 46% of women; which compares favorably with our results, notwithstanding the larger number of male victims (64%) in our study. Our cases provided peak involvement in the 25-44 and 45-64 year. Despite the small sample size, these results are consistent with the 2 frequency peaks observed in the literature.

We reported that vast majority of the poisoning was as a result of accidental domestic events. Donati *et al*. [6] also mentioned that the origin is predominantly accidental in 97% of cases and most often at home. Similar findings were found in the literature [7, 8]. We observed that poisoning occurred in winter with a peak in December in most of our cases. Other studies reported similar trend [9, 10, 11], mainly in winter possibly due to increased domestic use of gas furnaces, gas or kerosene space heaters and kitchen stoves.

The circumstances of poisoning were related to negligent behavior, ignorance of risks: using burning device in a poorly ventilated area without observing elementary precautionary rules [10, 11]. In our cases, the source of carbon monoxide was related to faulty device, inappropriate use, and lack of ventilation.

Autopsy findings in our cases revealed pulmonary petechial spots and organs congestion. Some studies [11] reported pulmonary congestion, red discoloration of mucous and serosal membranes, and cerebral oedema.

Carboxyhemoglobin levels are adjudged to be poisonous above 3% in non-smokers and above 10% in smokers [12] in our cases, the COHb assay was with a rate > 10% in non-smokers victims and with a rate > 20% in victims known chronic smokers.

Conclusion

Carbon monoxide poisoning is the leading cause of accidental poisoning deaths globally.

Understanding the epidemiological aspects will enable effective prevention strategies instituted towards reducing, eradicating or at least mitigating the morbidity and mortality of this poisoning. Roughly, our results are consistent with the world literature. However, our study suffers from several limitations: the results were based on the data available at the time of the autopsy and on the results of the forensic examination.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

References

1. Weaver LK. Carbon monoxide poisoning. NEngl J Med 2009;360:1217-1225.
2. Hmimou Rachid, Rhalem Naima, *et al*. Toxicovigilance, general and specific reports of the year 2016. Toxicology Morocco - N ° 31 - 4th quarter 2016, Anti Poison and Pharmacovigilance Center of Morocco.
3. Thom SR. "Hyperbaric-oxygen therapy for acute carbon monoxide poisoning". The New England Journal of Medicine. 347, (14).
4. Varon J, Marik PE, Fromm RE, Gueler A. "Carbon monoxide poisoning: A review for clinicians". The Journal of Emergency Medicine. 17(1), 87-93.
5. Anne-Hélène L, Pascaline L. Assessment of carbon monoxide poisoning declared in 2012 in the Loire Country, health bulletin - N ° 16 / October 2013, France.
6. Donati SY, Gainnier M, Chibane-Donati O. Carbonmonoxidepoisoning Anesthesia Resuscitation 2005;2:46-67.

7. Klein Kelly, Herzog Perri, Smolinske Susan, White Suzanne. Demand for poison control center services "surged" during the blackout". Clinical Toxicology 2003;45(3):248-54.
8. Mah JC. Non-fire carbon monoxide deaths and injuries associated with the use of consumer products: annual estimated 1998. http://www.cpsc.gov/library/data.html.
9. Kao LW, Nañagas KA. Toxicity associated with carbon monoxide". Clinics in Laboratory Medicine 1998;26(1):99-125.
10. Mehta SR, Niyogi M, Kasthuri AS, *et al*. Carbon monoxide poisoning. The Journal of the Association of Physicians of India [01 Jun 2001, 49:622-625]
11. Kumazawa T, Watanabe-Suzuki K. A curious autopsy case of accidental carbon monoxide poisoning in a motor vehicle. Leg Med (Tokyo) 2000;2(3):181-5.
12. Guzman JA. "Carbon monoxide poisoning". Critical care clinics 2012;28(4):537-48.