Journal of Forensic and Legal Medicine 48 (2017) 23–29

Contents lists available at ScienceDirect

Journal of Forensic and Legal Medicine

journal homepage: www.elsevier.com/locate/jflm

Carbon monoxide-related fatalities: A 60-year single institution experience

Martin Janík, M.D., PhD [a, *, 1], Michaela Ublová, M.D. [b, 1], Štepánka Kučerová, M.D. [b], Petr Hejna, M.D., PhD, MBA [b]

[a] Department of Forensic Medicine and Medicolegal Expertises, Jessenius Faculty of Medicine, Comenius University, University Hospital, Martin, Slovak Republic
[b] Department of Forensic Medicine, Faculty of Medicine, Charles University, University Hospital, Hradec Kralove, Czech Republic

ARTICLE INFO

Article history:
Received 20 January 2017
Accepted 12 April 2017
Available online 13 April 2017

Keywords:
Carbon monoxide
Poisoning
Fatality
Autopsy
Coal gas
Carboxyhemoglobin

ABSTRACT

Objective: Though carbon monoxide (CO) poisonings account currently for a relatively small percentage of total non-natural deaths in Europe, they represent a serious public health burden and significant component of avoidable mortality in many countries. Our aim was to investigate long-term trends and to determine epidemiologic characteristics of the CO-related deaths in the Czech Republic, recorded at the Department of Forensic Medicine in Hradec Králové.
Methods: This was an autopsy-based single-centre retrospective cohort study of all fatalities caused by CO poisoning over six decades (1947–2006). All data were numerically evaluated and processed using NCSS 10 Statistical Software. Statistical significance was defined as a *p*-value less than 0.05.
Results: A total of 1233 CO-related deaths were identified for inclusion in the study. The manner of death was ranked in order as follows: 45% accidental poisoning, 40% suicidal poisoning, 1% homicidal poisoning, 14% remained undetermined. There were slightly more male victims (59%) than female, and the mean age overall was 48 years. The majority of CO-related fatalities were attributed to coal gas inhalation, with the remainder being from inhaled motor vehicle exhaust fumes, inhaled fire smoke, and other combustion sources such as charcoal, gas and wood-burning appliances. The mean blood carboxyhemoglobin (COHb) level was 66%. A positive blood ethanol concentration was measured in 455 (37%) cases examined. Non-intentional poisonings were highly correlated with the winter months.
Conclusion: This study shows that the prevalence of CO-related deaths has decreased significantly in the Czech Republic following the widespread detoxification of the domestic gas in the 1990–1995. Our findings suggest that acute ethanol use, poorer socioeconomic position, and inadequate education status about the danger of CO are associated with an increased risk of fatal CO poisoning. Finally, our results demonstrate the continued value of the autopsy in monitoring global public health security issues and socioeconomic situation. Further similar large-scale studies in different populations are needed to improve the targeting of interventions to the groups with the highest level of risk, and to understand the sources of variation in CO-related mortality.
© 2017 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

1. Introduction

Carbon monoxide (CO) is a colorless, odorless and tasteless gas that is less dense than air and non-irritating. It is produced from the incomplete combustion of carbon-containing compounds. Although the global replacement of coal gas with non-toxic natural gas have contributed substantially towards a decline in the number of CO-related deaths, accidental CO poisoning remains in the cause of over half of all fatal poisonings annually all over the world.[1,2] Though CO poisoning account for a high percentage of total poisoning, almost all cases of accidental CO poisoning can be prevented with appropriate public education, and prevention programs on CO-emitting devices.[3]

* Corresponding author. Institute of Forensic Medicine and Medicolegal Expertises, Jessenius Faculty of Medicine, Comenius University, University Hospital, 036 59 Martin, Slovak Republic, EU.
E-mail address: janik.mato@gmail.com (M. Janík).
[1] The first two authors (Martin Janík and Michaela Ublová) contributed equally to this study.

http://dx.doi.org/10.1016/j.jflm.2017.04.002
1752-928X/© 2017 Elsevier Ltd and Faculty of Forensic and Legal Medicine. All rights reserved.

Forensically relevant sources of exogenous CO include predominantly inferior or faulty heating devices and gas-powered engines, motor vehicle exhaust fumes, fire-related inhaled smoke and burning charcoal. Rarely, CO poisoning may also result from methylene chloride (a common component of paint remover and other solvents). CO poisoning is infrequent, but potential life-threatening jeopardy of scuba diving.[4] Additionally, tobacco smoke is an important source of CO.

The mechanism of CO toxicity is tissue hypoxia and inhibition of cellular respiration, because the affinity of hemoglobin for CO is 210 times as great as its affinity for oxygen, and COHb liberates CO very slowly.[5] Recent investigations also suggest other mechanisms of CO-mediated toxicity. One hypothesis is that CO-induced tissue hypoxia may be followed by re-oxygenation injury to the central nervous system.[6,7] CO also causes inflammation by increasing levels of cytosolic heme and the heme oxygenase-1 protein, resulting in intracellular oxidative stress.[8]

In addition to fairy pathognomonic autopsy signs attributable to CO poisoning (cherry-red lividity, bright red coloration of the fingernail bed, blood, and the skeletal musculature), novel markers such as pulmonary macrophage activity, or expression of CIRBP, RBM3, and SIRT1 antigens in the myocardium or in the cerebellum could provide useful diagnostic information for revealing CO-induced hypoxic damage.[9–11] According to a recent study, bilateral globus pallidus necrosis, formerly described as a characteristic lesion for delayed CO poisoning, is now deemed non-specific and rarely associated with CO poisoning.[12]

The clinical signs of CO poisoning are said to be non-specific and vary with CO saturation levels, duration of exposure, pre-existing medical conditions and individual predisposition. Blood COHb concentrations of 5-10% may aggravate pre-existing cardiovascular diseases, while concentrations of 15-25% often cause dizziness and nausea. The levels of COHb exceeding 50% saturation are generally considered to be life-threatening. In the presence of alcohol or chronic cardiovascular disorder, however, fatal CO saturations may be significantly lower. Delayed neurotoxicity, which could occur 2–3 weeks after an acute CO exposure, may consist of bradykinesia, seizures, Parkinson's disease-like symptoms, and other cognitive impairments. In one study, patients who were 36 years of age or older or who had been exposed to CO for at least 24 h, or who had cerebellar abnormalities on presentation had an increased risk of cognitive sequelae at 6 weeks as compared with those without these characteristics.[13] Moreover, CO exposure has an especially deleterious effect on pregnant women, because of the greater sensitivity of the fetus to the harmful effects of the gas.[14]

The aim of this retrospective study was to assess long-term trends, demographic data, high-risk groups, the relationship between COHb concentrations and blood ethanol levels/age, the correlation between gender and time of poisoning, and sources of CO resulting in CO-related deaths, as recorded at the Department of Forensic Medicine in Hradec Králové (HK), Czech Republic, between 1947 and 2006.

2. Methods

The region of HK encompasses an area of 4758 square kilometers in northeastern Bohemia, with a population of more than half a million in 2016. The region of HK includes the city of HK, which consist of 93,000 residents. The Department of Forensic Medicine in HK investigates all sudden, unexpected, and non-natural deaths that occur within the region. This study was purely retrospective and relied on observational data recorded at the time of death. We included all cases of CO poisoning over a period of 60 years (1947–2006), which were autopsied at the Department of Forensic Medicine, HK. In each fatality, the autopsy report, warrant for post-mortem examination, police report, emergency report and hospital records (if any) were reviewed. The following details were evaluated: age, sex, time of year the death occurred, manner of death, concentration of COHb and blood ethanol level. The records were also reviewed for sources of CO and categorized as follows: coal gas leakage, fire-related smoke, motor vehicle exhaust fumes, inadequately ventilated gas heating sources and faulty wood furnaces. Descriptive analysis was presented with frequency (percentage) and mean (SD, standard deviation). The relationship between elevated COHb concentration and blood ethanol level was analyzed using Spearman's rank correlation coefficient. We also performed a chi-squared test to evaluate the relationship between gender and seasonality of CO poisoning. All data were numerically evaluated and processed using NCSS 10 Statistical Software. Statistical significance was defined as a p-value less than 0.05.

3. Results

3.1. Demographic profile

From the 36 189 autopsy records retrieved from January 1947 to December 2006, 1233 (3.4%) cases met inclusion criteria for the fatal CO poisoning. As shown in Fig. 1 the highest number CO-related fatalities were recorded in the 1970s and 1980s. In the following years, the overall trend indicated an obvious decrease in both accidental and suicidal CO poisoning. Male victims were slightly more common (731 cases, 59%), while 502 cases (41%) were

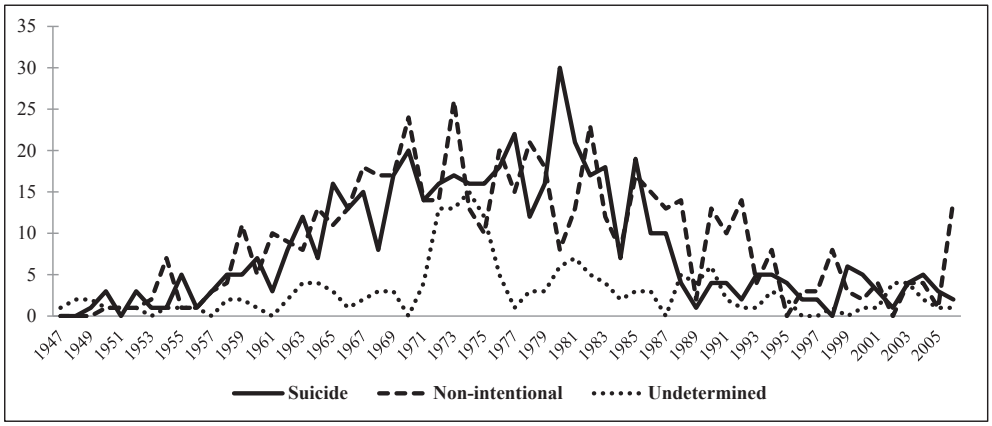

Fig. 1. Distribution of CO-related deaths (1947–2006).

Download English Version:

https://daneshyari.com/en/article/4760711

Download Persian Version:

https://daneshyari.com/article/4760711

Daneshyari.com