ORIGINAL ARTICLE

Effect of exhaust emissions on carbon monoxide levels in employees working at indoor car wash facilities

Topacoglu H[1], Katsakoglou S[2], Ipekci A[2]

[1]Emergency Department, Istanbul Training and Research Hospital
[2]Emergency Department, Okmeydani Training and Research Hospital
Istanbul, Turkey

Abstract

Background: Exhaust emissions from motor vehicles threaten the environment and human health. Carbon monoxide (CO) poisoning, especially the use of exhaust gas CO in suicidal attempts is well known in the literature. Recently, indoor car wash facilities established in large shopping malls with closed parking, lots is a new risk area that exposes car wash employees to prolonged periods of high level CO emissions from cars. The aim of this study was to investigate how carboxyhemoglobin (COHb) blood levels of employees get affected in confined areas with relatively poor air circulation.

Methods: Twenty male volunteers working in indoor parking car wash facilities were included in the study. Participants were informed about the aim of this study and their consent was obtained. Their pulse COHb levels were measured twice, at the beginning and at the end of the working day using Rad-57 pulse CO-oximeter device, allowing non-invasive measurement of COHb blood levels to compare the changes in their COHb levels before and after work.

Results: The mean age of the male volunteers was 29.8 ± 11.9 (range 18-55). While the mean COHb levels measured at the start of the working day was 2.1 ± 2.0 (range 0-9), it was increased to 5.2 ± 3.3 (range 1-15) at the end of work shift (Wilcoxon test, $p < 0.001$). There was a statistically significant difference in COHb levels between the beginning and the end of the work shift in smoker subjects, while the difference was not significant in the non-smoking group (Wilcoxon test, $p=0.001$, $p=0.102$, respectively).

Conclusion: The COHb blood levels of indoor car wash facility employees is directly impacted and gets elevated by motor vechile exhaust emissions. For the health of the employees at indoor parking car wash facilities, stricter precautions are needed and the government should not give permit to such operations. Hippokratia 2014; 18 (1): 37-39.

Keywords: Gas poisoning, occupational exposure, automobile exhaust, carbon monoxide (CO), carboxyhemoglobin (COHb)

Corresponding Author: Topacoglu Hakan, Associate Prof. Dr. Istanbul Training and Research Hospital (Samatya), Kasap Ilyas Mah. Org. Nafiz Gurman Cad. Kocamustafapasa Fatih 34098, Istanbul, Turkey, tel: +905324833122, fax: +902125884003, e-mail: hakan.topacoglu@deu.edu.tr, mdtopacov@yahoo.com

Introduction

Carbon monoxide (CO) is a tasteless, odorless and colorless gas. It is a by-product of partial combustion of organic compounds. Although general fires, charcoal stove emissions, LPG fueled portable heater emissions account for the majority of reported CO poisoning fatalities, with about one third of CO poisoning cases resulting in death stem from gasoline motor exhaust emissions[1-3]. These cases are often associated with malfunctioning or clogged motor vehicle exhaust systems but also, to a lesser extent, with CO induced suicide attempts. In addition, tobacco products consumption is considered a significant source of CO poisoning in humans.

Environmental pollution and its adverse effects on human health is one of the top issues which should be taken quite seriously. Vehicle exhaust emissions rise the levels of CO in the air. Especially in large cities, it was shown that air pollution from motor vehicle emissions accounts for about 70% and this amount is more than double of the air pollution due to heating sources[4].

The most common sources of CO emission into the atmosphere are mainly motor vehicle exhaust gases, industrial fires, gas-powered engines, forest fires and paints including methylene chloride. CO gas is heavier than air thus can accumulate quickly even in well-ventilated confined areas[4].

In Turkey, there are car wash facilities established at indoor parking of some shopping malls. In a study conducted with taxi drivers, traffic policemen and operators at gas station pumps it was found that these people contain higher blood levels of CO[5]. Making an analogy with relevant professions for people who may be exposed to high levels of CO, we postulated that car wash employees are likely to be prone to long-term exposure of motor vechile exhaust emissions thus may have high blood levels of CO as well. Therefore, the blood carbon monoxide

levels of indoor car wash facility workers was investigated in this study.

Material and Method

Twenty male car wash employees who were working at car wash facility located in the closed parking lots of 3 major shopping malls from different areas of Istanbul, were included in the study. All employees were informed about the aim of this study and their written consents were obtained as study participants. The study was conducted on a weekend, a period that the shopping mall vehicle traffic is the heaviest.

Before commencing the study, some demographic data such as age, gender, smoking history, period of active smoking, previous carbon monoxide poisoning related complaints/findings and history of other chronic diseases of the participants were recorded. Car wash employees pulse carboxyhemoglobin (COHb) levels were measured in the morning before starting work. The same measurement was performed at the end of 8-hour dayshift. For measurements, Rad-57 pulse CO-oximeter device (Masimo Corporation, Irvine, CA) allowing non-invasive measurement of blood carboxyhemoglobin was used to detect pulse COHb levels in these individuals.

Data was analyzed with the use of Statistical Package for the Social Science for windows, version 15.0 (SPSS Inc., Chicago, IL, USA). Elevation of COHb levels of car wash employees and the relationships with the demographic characteristics such as age, sex, comorbid diseases and smoking history were analyzed. Non-parametric tests (Wilcoxon Signed Rank test, Mann-Whitney U test) were used for the comparison of means.

Results

Twenty car washers that were included in the study were all males. The mean age of the study participants was 29.8 ± 11.9 years (range 18-55). The mean working period of the study participants was on average nine months. Fifteen study participants (75%) were smokers. The average active smoking period for the smoking group was 9.9 years. Twelve employees (60%) had chronic complaints, mostly from headache and fatigue.

The mean COHb level of car wash employees measured at the beginning of the working day was 2.1% ± 2.0 (range 0-9%), while the mean COHb levels at the end of work was 5.2% ± 3.3 (range 1-15%) (Wilcoxon Signed Rank test, $p<0.001$) (Table 1).

The mean COHb level of the nonsmoker car wash employees was 0.4% ± 0.9 at the beginning of the working day, while the mean COHb level of smokers was 2.6% ± 2.0 (Mann-Whitney U test, $p=0.008$). The mean COHb level of non-smokers at the end of work was 2.6% ± 2.5, while mean COHb level of smokers was around 6.0% ± 3.2 (Mann-Whitney U test, $p=0.066$) (Table 1).

Amongst car wash employees who had complaints of chronic headaches and fatigue, mean COHb levels was 2.7% ± 2.3 in the beginning of work day. At the end of work day this value was measured to be 5.6 ± 3.9 (Wilcoxon test, $p=0.005$). Amongst car wash employees who reported no complaints, mean COHb levels in the beginning of work day was 1.1% ± 1.1, while it increased to 4.5% ± 2.3 increased to the end of work shift (Wilcoxon Signed Rank test, $p<0.018$) (Table 2).

Discussion

The most common cause of acute poisoning related deaths in developped nations is CO poisoning and the major source of such deaths stem from general fire related CO poisonings[6]. However, in developped nations, although a significant portion of CO poisoning related deaths is attributed to suicides, in Turkey, suicidal deaths from CO poisoning are quite rare[7]. A large portion of accidental toxic gas poisoning has been reported to be associated with motor vechile exhaust fumes[8].

In general, it is known that pulse COHb levels may be between 3-8% in regular smokers. This can be as high as 10% in heavy smokers and drivers who work in heavy traffic areas[9]. It has also been reported that the CO blood levels increase in water-pipe smokers[10].

Despite the fact that signs and symptoms of CO poisoning can occur early, they can also appear after several weeks. The clinical findings associated with CO poisoning have a rather large spectrum[3,6].

Although CO poisoning usually develops in confined spaces, CO poisoning after exposure in the open air have also been reported in the literature[11,12].

In acute CO toxicity, cases symptoms like fatigue, signs of upper respiratory tract infections, dyspnea, chest pain, palpitations, lethargy, confusion, depression, hallucinations, agitation, vomiting, diarrhea, abdominal pain, headache, dizziness, confusion, blurred vision, syncope, seizure, urinary incontinence, memory and gait disturbance, neurological disorders and coma may occur. In chronic poisoning, in addition to acute symptoms, cognitive functions impairment and gradually developing psychiatric symptoms may develop[3,6,13]. CO poisoning cases may be misdiagnosed since initial symptoms include fatigue, headache, dizziness, eye tearing, nausea, vomiting which are symptoms that are usually attributed to either common flu, gastroenteritis or food poisoning[3,6,13].

The most common chronic complaints of indoor parking car wash facility employees were headache and fatigue. However, no statistically significant correlation was found between the levels of COHb and these chronic complaints. In addition, chronic symptoms were not associated with cigarette smoking ($p>0.05$). There was no difference in COHb levels for car wash employees complaining about headache and fatigue versus those without any complaints. However, it was observed that the pulse COHb levels in both groups increased at the end of the work shift but the source of their chronic complaints may stem from other causes and not from exposure to exhaust fumes.

It was determined that the mean COHb levels in smokers at the end of work day exhibited statistically significant increase as compared to the beginning of work day (6.0 vs 2.6, respectively, Wilcoxon, $p<0.001$), while measurements made under the same conditions in non-smokers group, there was

Table 1: Measured pulse carboxyhemoglobin (COHb) levels in smokers and non-smoker car wash employees at the beginning and at the end of work shift.

	No	Pulse COHb levels in the beginning of work shift (%) ± Standard Deviation	Pulse COHb levels in the end of 8-hour work shift (%) ± Standard Deviation	p value**
All car washers	20	2.1% ± 2.0	5.2% ± 3.3	<0.001
Smoker	15	2.6% ± 2.0	6.0% ± 3.2	0.001
Non-smoker	5	0.4% ± 0.9	2.6% ± 2.5	0.102

** Wilcoxon Signed Rank Test.

Table 2: The relationship between chronic complaints of car wash employees and their pulse COHb levels

	No complaints	Headache and fatigue	p value*
No	8	12	
Pulse COHb levels at the beginning of work shift (%) ± Standard Deviation	1.1% ± 1.1	2.7% ± 2.3	0.069
Pulse COHb levels at the end of 8-hour work shift (%) ± Standard Deviation	4.5% ± 2.3	5.6% ± 3.9	0.734
p value**	0.018	0.005	

**Wilcoxon Signed Rank test, *Mann-Whitney U test.

no statistically significant difference (2.6 vs 0.4, respectively, Wilcoxon, p=0.102). From this result, it may be deduced that non-smokers working in a closed area under these conditions may be more vulnerable to toxic gas exposure effects. However, it should be noted that the mean COHb levels in non-smokers as compared to smokers at the end of work day was not significantly different (p=0.066). Based on the results shown in Table 1, it can be concluded that despite the fact that the pulse COHb levels in the non-smoking group was not increased, both groups seem to be affected similarly at the end of the work shift.

Conclusion

In major cities in Turkey, indoor parking facilities can acquire car wash service operation licence. It is very important to alert the employees on such facilities about this health issue. This can be considered as an occupational disease. In this study, the pulse COHb levels of the car washers working at indoor car wash facilities were found to be at levels that can necessitate clinical intervention. It is evident that these workers are subjected to chronic repetitive exposure to CO. Therefore, caution should be exercised, especially about chronic sequelae. It was found out that none of the workers included in this study had any idea about the possibility of CO poisoning due to their working conditions. Based on the results of this study, it can be concluded that working at indoor carwash facilities carry occupational health hazards. Therefore, workers in such facilities should be aware of using personal protective equipments such as masks as a protective measure.

Conflict of interest

The authors state no conflict of interest.

References

1. Prockop LD, Chichkova RI. Carbon monoxide intoxication: an updated review. J Neurol Sci, 2007; 262:122-130.
2. Hoffman RS, Nelson LS, Howland MA, Lewin NA, Flomenbaum NE, Goldfrank LR Carbon Monoxide. Goldfrank's Manuel of Toxicologic Emergencies, 8th edition. McGraw-Hill, New York, 2007, 151-153.
3. Van Meter KW. Carbon Monoxide Poisining. Tintinalli JE, Kelen GD, Stapczynski JS (eds), Emergency Medicine A Comprehensive Study Guide, 6th edition. McGraw-Hill, New York, NY, 2010, 1238-1241.
4. Centers for Diseases Control and Prevention. Carbon Monoxide hazards from small gasoline powered engines. http://www.cdc.gov/niosh/topics/co/ (Accessed: 21/07/2013).
5. Yilmaz A, Guvendik G. The blood carboxyhemoglobin levels of individuals occupationally exposed to exhaust pollution. J Fac Pharm Ankara. 2003; 32: 213-219.
6. Nelson LS, Hoffman RS. Carbon Monoxide. Rosen's Emergency Medicine: Concepts and Clinical Practice. Marx J, Hockberger R, Walls R (eds), 7th edition. Philadelphia, MOSBY Elsevier, 2010, 2037-2038.
7. Metin S, Yildiz S, Cakmak T, Demirbas S. Frequency of Carbon Monoxide Poisoning in Turkey in 2010. TAF Prev Med Bull. 2011; 10: 587-592.
8. Cobb N, Etzel RA. Unintentional carbon monoxide-related deaths in the United States, 1979 through 1988. JAMA. 1991; 266: 659-663.
9. Sen S, Peltz C, Beard J, Zeno B. Recurrent carbon monoxide poisoning from cigarette smoking. Am J Med Sci. 2010; 340: 427-428.
10. La Fauci G, Weiser G, Steiner IP, Shavit I. Carbon monoxide poisoning in narghile (water pipe) tobacco smokers. CJEM. 2012; 14: 57-59.
11. Easley RB. Open air carbon monoxide poisoning in a child swimming behind a boat. South Med J. 2000; 93: 430-432.
12. Center of Disease Control and Prevention (CDC). Carbon-monoxide poisoning resulting from exposure to ski-boat exhaust--Georgia, June 2002. MMWR Morb Mortal Wkly Rep. 2002; 51: 829-830.
13. Shochat GN. Luchessi M. Carbonmonoxide Toxicity Clinical Presentation. Medscape, availiable at: http://emedicine.medscape.com/article/819987-clinical, Accessed: 21/07/2013.