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ORIGINAL RESEARCH

The evaluation level of carboxyhemoglobin in children blood<3y-14y> with chief complain of headache, nausea, and dizziness referring to pediatric clinics of Loghman hakim hospital in year 2018-2019

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Abstract

Carbon monoxide poisoning is common, challenging and serious poisoning with wide range of non-specific flu-like clinical manifestations that leads to misdiagnosis. This cross-sectional descriptive controlled study conducted in Loghman Hakim Hospital on 3-14 year-old patients presenting with non-specific Flu-like (headache, dizziness, nausea, vomiting, malaise) symptoms from November 2018 to May2019. In all subjects carboxyhemoglobin level measured via noninvasive pulse CO-oximetry (Massimo Company, USA). Demographic data, cigarette, shisha, opium smoke exposure, type of home heater, carboxyhemoglobin level were collected and statistically analyzed via SPSS v16.0. A total of 93 children 3-14 year-old were enrolled the study. Their mean age was 4.6±4.3 years, 46% were male and54% female. Mean carboxyhemoglobin level was 27.8±9.7 %(range 2.7% to 44%). The most frequently encountered symptoms were nausea &vomiting (44%), dizziness (36%), headache (32%) and myalgia (23%). We obtained the COHb levels using noninvasive pulse oximeter for all study patients and their mother, and the levels > 5% for non-smokers were considered as CO poisoning. Of the 93 study patients, 49%had normal carboxyhemoglobin levels (CoHb level< 5%). Of the remaining 51% study patients, 47 patients had CoHb levels between 5% and 10%, and seven patients > 10%. Closer attention to early and nonspecific signs and symptoms of Carbon Monoxide poisoning and higher clinical suspicion could reduce the rate of misdiagnosis and therefore minimize complications in this serious poisoning.

Keywords: Child, Carbon Monoxide, Poisoning, Nonspecific flu

Introduction

Carbon monoxide (CO), the hidden poison, is a colorless, non-irritant odorless extremely dangerous gas produced from incomplete combustion of carbon-containing fuels. The incidence, mortality and case fatality rates of this "Silent Killer" is high in Iran, particularly in young individuals (1). CO has high affinity to heme proteins like; hemoglobin (200 times greater than oxygen) (2) , Myoglobin (60 times greater than oxygen) & Cytochrome C Oxidase. CO displaces nitric oxide from proteins that bind with free radicals to form the toxic metabolite peroxynitrite, leading to lipid peroxidation, vasodilatation and cellular damage (2). Finally leads to tissue hypoxia with various clinical effects. CO poisoned patients can present with various vague and confusing symptoms ranging from headache and dizziness to coma and death .There are no specific signs or symptoms of CO poisoning. Mostly, non-specific minor symptoms like nausea, vomiting, headache, dizziness, difficulty in concentrating and serious major symptoms, such as syncope and convulsion are seen. So it is very important to be aware of CO exposure during the admission of patient in hospital mainly in cold weather, unfortunately detection of CO poisoned patients may be difficult. Actually, lots of patients with CO poisoning are missed due to non-specific symptoms and insufficient awareness of both the parents and the physician that can lead to significant morbidity and mortality. If we can diagnose and treat this poisoning in early & mild stages with subtle and non-specific Flu-like manifestations the prognosis is much more favorable. These symptoms are often misdiagnosed as flu, winter viruses, food poisoning and long list of differential diagnoses. Physical examination usually are unremarkable (3). CO poisoning can be diagnosed by measuring carboxyhemoglobin (COHb) levels either with arterial blood gas analysis or with a pulse CO meter capable of measuring COHb level, a technology commercially available since 2005 (4). This rapid, noninvasive measurement of carboxyhemoglobin levels could offer lots of benefits (5). Luckily noninvasive this device is accessible in Loghman-Hakim Hospital recently. Normal levels of COHb range from 0% to 5% and up to10% in smokers. In hyperbilirubinemia, newborn period, hemolytic anemia, Vitamin B12 injection and breathing air polluted with high CO content levels may be increased (6). The aim of our study was to emphasize the significance of early diagnosis of CO poisoning with non-invasive measurement of CO levels in children presenting with non-specific Flu-like symptoms who had no recognized exposure using a pulse oximeter device (4,6).

Materials and Methods

Our study is a cross-sectional descriptive study. Ninety three children between 3 and 14 year-old who presented to Loghman Hakim Hospital with one or more complaints of non-specific influenza like symptoms including headache, dizziness, nausea (at least 1 symptom) during the cold months (from November 2018 to May2019) without fever or initial diagnosis of CO poisoning were enrolled the study. Patients with chronic disease, fever and infection and patient who presented with CO poisoning were excluded. Demographic data, type and location of home, cigarette, shisha, opium smoke exposure, type of home heater, chimney, stove, admission time, number of people with the same complaint in family, comorbidities, medications used that falsely affect the COHgb level (Vit B12) were collected by the managing physician and fill out the questionnaire. The carboxyhemoglobin level were measured by means of CO-oximetry (Massimo Company ,USA) that was checked and controlled during our study and functioned within the manufacturer's specification of ± 2 percentage points, were recorded for all patients. Statistical significance between data was analyzed via SPSS v16.0, Significance was defined as $p < 0.05$.

Results

A total of 93 patients 3-14 year-old who were willing to participate, enrolled the study. The mean age was 4.6±4.3year. 42 patients (46%) were male and 51 were female (54%). There was no significant difference in demographic factors between two groups ($p > 0.05$). Chronic passive smoke exposure including cigarette, shisha or opium was reported in 41% of patients. None of patients had positive history for transfusion or Vitamin B12 injection. Most of patients were referred to

hospital within the first six hours after being symptomatic and in 86% symptoms were begun at home (45% of them had carboxyhemoglobin level>5%), in 9% symptoms started at school. Living space is showed in table1.

Table1: *Living space and Carboxyhemoglobin level of patients.*

Home space	Number (%)	CO level>5%
<50 m^2	32(35%)	26%
50-100m^2	44(47%)	18%
>100m^2	17(18%)	4%

As showed in table 2 more than 1 source of home heating system associated with more CoHb levels (table 2).

Table 2: *Source of home heating system and Carboxyhemoglobin level of patients.*

Source	Number (%)	CO level
Heater	47(51%)	CO<5%=24 CO>5%=23
Package	12(13%)	CO<5%=8 CO>5%=6
Water heater	11(12%)	CO<5%=4 CO>5%=8
Fireplace	3(4%)	CO<5%=1 CO>5%=2
More than 1	9(10%)	CO<5%=9 CO>5%=21

The most frequently encountered symptoms (Table 3) were nausea &vomiting (44%), dizziness (36%), headache (32%) and, myalgia (23%). We obtained the COHb levels using noninvasive pulse oximeter for all study patients and their mother, and the levels > 5% for non-smokers were considered as diagnostic criteria for CO poisoning, all of cases were non-smoker.

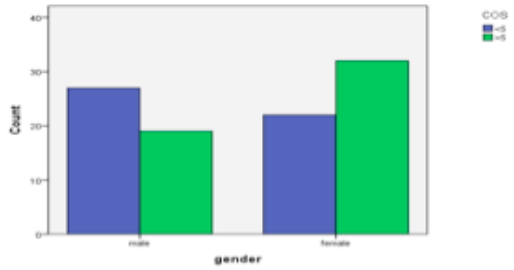

Figure 1. Distribution related to carboxihemoglobin levels

Carboxyhemoglobin level>5% was more common in cigarette, fireplace and shisha exposed children. Similar symptoms were observed in other family members of our cases with Mean carboxyhemoglobin level: 27.8±9.7% (range 2.7% to 44%). Of the 93 study patients 49% had normal carboxyhemoglobin levels (less than 5%). Of the remaining 51% study patients, 47 patients had carboxyhemoglobin levels between 5% and 10%, and seven patients greater than 10%.

Mean age of the patients who had CO poisoning was significantly lower than that of the patients who did not have CO poisoning (28.12 years and 42.79 years, respectively). The frequency of symptoms did not significantly differ between study groups. Sex distribution related to carboxyhemoglobin levels (<5%=normal, >5% abnormal) illustrated in Figure1 that was not statistically significance.

Table3: *The most frequently symptoms and Carboxyhemoglobin level of patients.*

Symptom	Carboxyhemoglobin level		Total
	<5% number (%)	>5% number (%)	
Nausea/vomiting	7(8%)	4(3%)	11(11%)
Headache	2(2%)	4(4%)	6(6%)
Dizziness	6(6%)	6(6%)	12(12%)
Myalgia	3(3%)	3(3%)	6(6%)
More than 1 symptom	25(26%)	30(32%)	55(58%)
Total	46 (49%)	47(51%)	93(100%)

Discussion

Co poisoning still continues to cause serious poisoning, neurologic sequelae and death. Mild intoxication may have non-specific and obscure presenting signs. With regard to age of the patient, headache is one of the most common symptoms. Hassan Amir et al showed that headache in cold months of year could be the only symptom of carbon monoxide poisoning in adults (7). Mary Eberhardt et al reported that elevated CO levels were present in over 7% of ED adult patients with headaches (8). Headache was found to be the most common presenting symptom in patients with CO by Lucas et al. (2010) too. Dolan et al investigated patients presenting to the emergency department with flu-like symptoms, 23.6% had COHB levels greater than 10%. They suggested that subacute occult carbon monoxide poisoning is commonly misdiagnosed as an influenza-like viral illness particularly in inner-city populations during the heating months (9).

Similar to our study Baker MD et al. eliminated patients with fever, diarrhea, and viral exanthema from their study population to (theoretically) minimize sampling in children presumed to have normal carboxyhemoglobin levels and their results indicated that no specific symptom complex could help in distinguishing carbon monoxide poisoning from a presumed viral illness (11).

Common signs of Co poisoning reported by Keels A et al. were headache in 55%, nausea

in 49%, dizziness in 44%, syncope in 28%, and seizures in 4%.

Hampson NB, Hampson LA demonstrated that mean carboxyhemoglobin level in 34 female and 66 male patients with carbon monoxide-associated headache was 21.3%+/- 9.3% (4).

Failure to diagnose CO poisoning may result in significant morbidity and mortality and high index of suspicion must be maintained for occult CO exposure. Headache, particularly when associated with certain environments, and flulike illness in the wintertime with symptomatic cohabitants should raise the index of suspicion in the ED significantly for occult CO poisoning (12). Unfortunately if physicians have not high index of suspicion Carbon monoxide poisoning undetected by both patients and doctors (13).

Serrate Keyence et al. stated that both measurement methods of carboxyhemoglobin levels (noninvasive pulse CO-oximeter and by ABG) strongly correlated with each other, hopefully non-invasive pulse CO-oximeter is an easy, rapid and useful screening tool for diagnosis of CO poisoning (10).

Barker SJ et al. examines Massimo Rad-57 device's ability to measure dyshemoglobins in human volunteers as the first commercially available pulse oximeter and showed that this device measured carboxyhemoglobin with an uncertainty of +/-2% compared with the blood gas analyzer (11).

Similar to our results, Deniz T et al. recommended that measurement of carboxyhemoglobin levels of patients presenting to ED due to non-specific symptoms like headache and dizziness using a pulse CO-oximeter should be a part of the routine of emergency medicine triage (15).

Conclusion

This study showed that CO poisoning is common in patients with nonspecific symptoms, and measurement of carboxyhemoglobin levels is an easy, fast, noninvasive and useful method not only in patients referred to hospital with main complaint of carbon monoxide poisoning, but also for patients presenting due to non-specific flu-like symptoms particularly if the patient is afebrile and similar symptoms was observed in other family members, especially during cold months. Thus using a pulse CO-oximeter should be a part of routine emergency medicine triage. Finally, early diagnosis of CO poisoning decrease disease severity, additional unnecessary exams, and complications related to misdiagnosis.

Conflict of interest

The authors have no conflict of interest to declare.

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