

Multiple Patients with Carbon Monoxide Toxicity from Water-Pipe Smoking

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Abbreviations:

COHb: carboxyhemoglobin
 CO: carbon monoxide
 CRCE: Centre for Radiation, Chemical and Environmental Hazards of the HPA
 ED: Emergency Department
 HPA: Health Protection Agency
 NHS: National Health Service
 PAH: polynuclear aromatic hydrocarbons

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Abstract

This case report describes carbon monoxide toxicity from prolonged shisha (water-pipe) smoking. The evidence base for the source and pathway of toxicity is discussed. This practice has been increasing in the UK in recent years, and emergency physicians need to be aware of the high levels of CO, with the consequent risk of clinical poisoning from water-pipe smoking.

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Introduction

Water-pipe smoking has been practiced for centuries in the Middle East, the Indian subcontinent and China^{1,2} and it is referred to by a number of different names: shisha, sheesha, narghile, hookah, hubble-bubble. Its use has spread geographically in recent years²⁻⁵ and it is becoming more popular in the UK.⁶ Practitioners often consider water-pipe smoking to be safer than smoking cigarettes because they believe that the water trap acts as an effective filter.^{1,2,6} However, there is an increasing body of evidence to suggest that water-pipe smoking is associated with higher levels of toxins, including carbon monoxide (CO).⁷⁻¹²

A number of cases of symptomatic carbon monoxide poisoning caused by water-pipe smoking presented to the Emergency Department (ED) of one study site during a CO prevalence project. This paper reports a series of cases of CO toxicity from water-pipe use in the UK and aims to highlight this problem to clinicians. Data were collected retrospectively from the contemporaneous medical records.

Case Series

Two patients were brought together to the ED by ambulance at 4 AM, both complaining of dizziness, light-headedness, and headache which had developed suddenly while both were at the same party. Ten minutes later, three more patients self-presented, complaining of non-specific symptoms. The triage nurse rapidly identified that these two groups of patients had been at the same event. A screening study of CO exposure was being undertaken in the ED at the time, so carboxyhemoglobin (COHb) levels were measured using a pulse CO-oximeter. This identified that the patients had high levels of COHb. Seven more patients subsequently presented, all with varying degrees of neurological symptoms and raised COHb levels.

It became apparent that all of the patients had been smoking water-pipes; some described smoking a total of three or four pipes during the course of the night. The ED contacted the ambulance service whose Hazardous Area Response Team, along with the Fire and Rescue Service, investigated the scene of the party. In a restaurant, they discovered a basement room where the private event had been held. The room contained approximately 10 water-pipes in addition to a separate open charcoal burner in the same enclosed space, which was described as poorly ventilated. The emergency services recorded a dangerously high atmospheric CO level of 440 ppm in the room.

The patients from the event were treated with high-flow oxygen (12-15 liters per minute via a mask fitted with a reservoir bag) until they were asymptomatic and their levels dropped to below 5%. All patients who were transported to the ED by ambulance

Age/ Gender	Arrival time (AM)	Mode of Arrival	Clinical Features	CO Level at Triage: Pulse CO-oximeter (%)	CO Level after 2 h: ABG (%)	CO Level at Discharge: ABG (%)	Length of Stay in ED
30/Male	4:00	On foot	Headache	15	11.4	2.8	5 h
34/Male	4.08	On foot	Headache	21	12	2.6	5 h 30 min
38/Male	4.09	On foot	Headache, dizziness	18	8.6	1.8	5 h 21 min
26/Male	4.17	On foot	headache	20	16.5	3.7	4 h 47 min
21/Female	4.30	Ambulance	Headache, lethargy, nausea	18	5.3	<0.5	5 h
21/Female	4.35	Ambulance	Dizziness	7.3	2.0	N/A	4 h 55 min
31/Male	4.45	On foot	Headache	23	14.2	2.2	4 h 45 min
19/Female	4.49	Ambulance	No symptoms	2	Self-discharged	Self-discharged	51 min
22/Female	4.52	Ambulance	Nausea, dizziness	14	12	3.1	4 h 38 min
17/Female	5.54	Ambulance	Dizziness, headache	12	4.9	N/A	2 h 36 min
18/Male	6.05	Ambulance	Dizziness, headache	25 on scene; 8 on ED arrival	6.4	Self-discharged	2 h 50 min
22/Female	6.38	Ambulance	Dizziness	15	5.9	2.1	1 h 22 min

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Table 1. Summary of the Patients Presenting Following Water-pipe Smoking
Abbreviations: ABG, arterial blood gas; ED, emergency department.

were given high-flow oxygen prior to arriving at the hospital, although the duration of treatment was not recorded. None of the patients had any features of severe poisoning; all had ECGs recorded which were unremarkable; and all were discharged home within six hours following advice from the Health Protection Agency (HPA). All patients reported full resolution of symptoms on discharge.

Overall, the mean COHb was 14% (median 15%, range 2%–23%). Levels of COHb were higher in males (mean 17.5%, median 19%, range 8%–23%) than in females (mean 11.4%, median 13%, range 2%–18%). Notably, median COHb levels were also higher in self-presenters (12%, $n = 5$) compared with those using an ambulance (5.9%, $n = 7$) possibly because oxygen therapy was started by ambulance crews. A summary of the cases is shown in Table 1.

Subsequent public health follow up indicated that seven additional persons had been exposed but had not sought medical attention.

These cases were reported to the Centre for Radiation, Chemical and Environmental Hazards (CRCE) of the HPA. A review of the CRCE national database was undertaken; also, the electronic records of the local Health Protection Units (local acute public health providers) were scrutinized. This revealed only five CO poisoning incidents associated with water-pipe smoking reported to CRCE since 2008. Of these, three were reported from the London region in 2010, representing almost 20% of all CO poisoning

incidents reported to the region ($n = 16$). The two earlier cases were reported from Birmingham and Leicester, respectively. Apart from the incident described above, each of the other incidents ($n = 4$) involved only one person smoking a water-pipe indoors in a residential property, often with poor ventilation and for extended periods of time. The incidents took place during winter and early spring (January 4 to April 3). All cases were males with an age range of 15–59 years. Levels of COHb ranged from 9.7%–29% and symptoms ranged from headaches and/or palpitations to semi-consciousness and collapse and were not always well correlated to the actual COHb level. Other exposed persons from the same household (range 1–4) were assessed in these single-person incidents, but none of them had any symptoms or raised COHb levels. All cases were treated with high-flow oxygen and experienced rapid recovery. It is routine procedure to check all relevant gas appliances and this is carried out by the gas supplier or the local authority. In none of these cases were any faulty appliances identified and water-pipe smoking was concluded to be the likely cause.

Discussion

Water-pipe smoking in the Middle East, the Indian Subcontinent and China has been practiced for a number of centuries;^{1,2} in the past decade, its use has spread to the US^{2,3} and Europe,² including France,⁴ Switzerland⁵ and the UK.⁶

Water-pipes come in a wide variety of designs and are called by different names, depending on the geographical region where

they are used, but they all follow the same principle. A water-pipe is a device where tobacco is heated by burning charcoal; the burner is usually located on top of the body of the water-pipe. When the user breathes in using the pipe, the tobacco smoke is drawn through a water trap in the body of the device before being inhaled. Smoking habits are different from those of cigarette users: although there is a longer interval between inhalations, the breaths taken are deeper,⁵ and water-pipes tend to be smoked in groups with sessions lasting 45-60 min.² The water trap cools the smoke and is believed to dissolve soluble toxins, which is why it is commonly perceived to be safer than smoking cigarettes;^{1,2,6} however, there is an increasing body of evidence to suggest the opposite.

One study found the CO levels in the inhaled smoke derived from water-pipe tobacco (0.34-1.4%) was not significantly different from cigarette smoke (0.4%);¹³ however, the smoke from the charcoals in the burner were not measured. A second study showed that 90% of the CO (and 75-95% of carcinogenic polynuclear aromatic hydrocarbons (PAHs) emitted from water-pipes come from the charcoal.¹⁴ This smoke is also inhaled by the users, as suggested by two other studies that showed significantly higher CO and PAH levels in the exhaled breath of people who had smoked a water-pipe for one hour compared with those who had smoked a single cigarette.^{7,8} Although there are no studies assessing the effect of passive water-pipe smoking, there is likely to be a risk of significant CO exposure in those who are in the vicinity of water-pipe smoking, even if they are not indulging in the practice themselves.

Similarly, carboxyhemoglobin levels have consistently been shown to be higher in water-pipe users than cigarette smokers. Zahran and colleagues showed that baseline carboxyhemoglobin levels were higher both in the mornings and evenings in water-pipe

smokers.^{9,10} Acute changes in carboxyhemoglobin after water-pipe use have also shown to increase 3-10 times more than the increases in carboxyhemoglobin after a cigarette.^{11,12} A single case report showed a blood carboxyhemoglobin level of 27.8% associated with dizziness, both of which settled with high-flow oxygen therapy.¹⁵

The cases identified in this series have highlighted that water-pipe smoking is associated with a risk of CO toxicity. Factors that seem to increase this risk are a prolonged smoking session and smoking in a poorly ventilated area. The spread of water-pipe use to countries with colder climates means that smoking is more likely to be undertaken indoors with an increased risk of high CO exposure. The use of fossil fuel heating appliances, such as the charcoal burner found at the scene of this series, will add to the potential toxic burden. It seems that water-pipe use is becoming more common, therefore clinicians should be aware of this problem; COHb levels should be measured in those who have been smoking water-pipes and who have symptoms suggestive of carbon monoxide poisoning. Also, patients who present with symptoms such as non-traumatic headaches, flu-like symptoms, or dizziness should be asked about water-pipe use in addition to questions about fossil fuel appliances at home and potential occupational exposures.

Conclusions

Water-pipe use appears to be on the increase in the UK. The cases presented and a review of the limited previously published data indicates that it is associated with a risk of carbon monoxide toxicity. Clinicians should be vigilant about the potential for carbon monoxide poisoning in both active and passive water-pipe smokers.

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