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### Carbon Monoxide Poisoning Secondary to Hookah Smoking

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Hookah smoking, at one time confined to North Africa, the eastern Mediterranean region, the Arabian peninsula, and Southeast Asia, has begun to spread throughout the world. As some practices of eastern and Arab cultures reach the United States, the number of people using hookah on an experimental or regular basis has increased. Carbon monoxide poisoning can be a common adverse effect, possibly undetected by physicians, in hookah smokers. The authors report a case of carbon monoxide poisoning secondary to smoking tobacco through a hookah.

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Hookah—also known as argileh, goza, narghile, hubble-bubble, and shisha—is a water pipe for smoking tobacco. Hookahs have been used in social activity from Africa to Southeast Asia for more than 400 years.<sup>1</sup> It has spread worldwide and has become a recreational practice among adolescents and young adults in the United States, Europe, and Brazil.<sup>1</sup> Smoke generated through a water pipe has increased levels of carcinogens, carbon monoxide, nicotine, and tar.<sup>2,3</sup> Research has shown that hookah smokers have substantially higher levels of carboxyhemoglobin (COHb), an accurate marker of carbon

monoxide in the blood, compared with individuals who smoke cigarettes.<sup>3-5</sup> The authors report a case of carbon monoxide poisoning secondary to hookah smoke inhalation that manifested as syncope. A basic explanation of hookah smoking, its health effects, and treatments for carbon monoxide poisoning are provided.

#### Report of Case

A 21-year-old man presented to the emergency department with an episode of syncope. His family was at bedside and noted that the patient had lost consciousness after an episode of emesis. The patient's vomit was nonbloody and nonbilious, and the family reported that the patient was unconscious for only several seconds. The patient denied any chest pain, dizziness, or weakness prior to the event. The family noted that the patient had been outdoors all day at a family function, where the temperature was high. On arrival to the emergency department, the patient complained of headache and nausea.

The patient's medical history was significant for a recent diagnosis of gallstones. Family history was negative for any cardiac or neurologic diseases. He stated that he drank alcohol and smoked only socially and occasionally. The patient did report, however, that he drank alcohol earlier in the day and smoked tobacco from a hookah.

Physical examination revealed that the patient was intoxicated but alert, oriented, and in no acute distress. His vital signs included a body temperature of 97.5°F, a blood pressure of 138/80 mm Hg, a pulse of 97 beats per minute, a respiratory rate of 22 breaths per minute, and an oxygen saturation of 98%. Mucous membranes were dry, but the patient had good skin turgor. Skin was warm and dry with no obvious discoloration or rash. Results of cardiovascular, pulmonary, and neurologic examinations were unremarkable. An electrocardiogram revealed a normal sinus rhythm with a rate of 95 beats per minute and a normal axis deviation with no evidence of ischemia. Laboratory test results showed an unremarkable complete blood cell count and comprehensive metabolic blood panel. Blood tests were negative for the presence of cardiac enzymes, aspirin, and acetaminophen. The patient's ethanol level was 169 mg/dL (normal-negative). The COHb level was substantially elevated at 15.3% (normal: 1-2 packs per day, 4%-5%; elevated: >2 packs per day, 8%-9%). A com-

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puted tomographic image of the head revealed no acute abnormalities.

Carbon monoxide poisoning secondary to hookah smoking was diagnosed, and the patient was administered high-flow oxygen by means of a nonrebreathing mask. The patient was admitted to the hospital for further evaluation and treatment. Carboxyhemoglobin was measured again 12 hours later, and the level was 1.3%. At that time, the patient was asymptomatic and was discharged home.

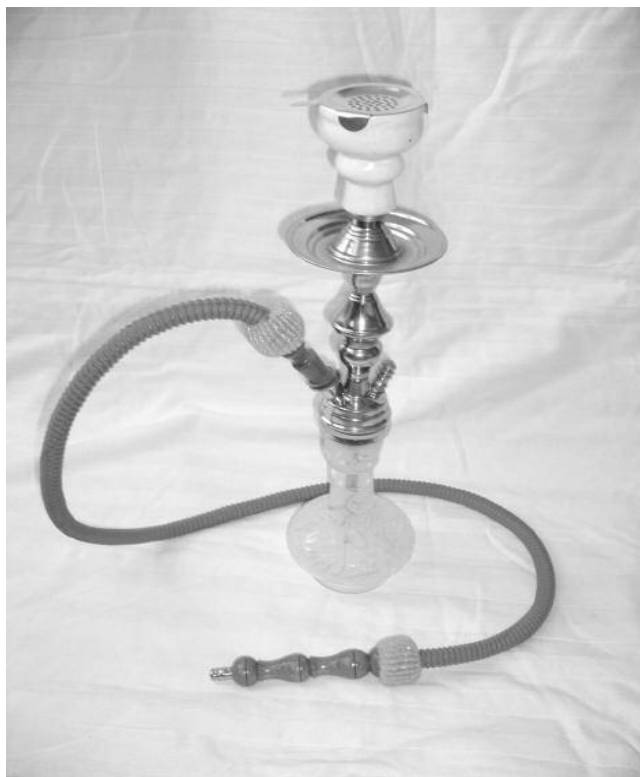
### Comment

A hookah is composed of a head, body, water bowl, hose, and mouthpiece (Figure). Tobacco is placed in the bowl at the top, is covered with perforated aluminum foil. A burning piece of charcoal is placed on the aluminum foil, which heats the tobacco. Smoke then travels down the body of the hookah, into a half-filled water bowl, and through a submerged tube. Inhalation through the mouthpiece produces a vacuum effect that pulls the smoke through the water and then the mouthpiece.

Each year, 4.9 million deaths worldwide are attributed to smoking and 70% are in developing countries.<sup>6</sup> In Arab countries, between 22% and 50% of men and between 23% and 70% of women have admitted to using a water pipe.<sup>6</sup> In the United States, however, there is still a stark difference in the number of people using a water pipe for tobacco consumption. Two studies<sup>7,8</sup> have shown that 15% of US adolescents have used a water pipe and that water pipe users often believe water pipes carry less risk than traditional cigarettes.

One risk that is often overlooked by both hookah smokers and physicians is carbon monoxide poisoning. Carbon monoxide is a cellular toxin that binds to hemoglobin up to 300 times more tightly than oxygen does.<sup>9</sup> Physiologically, hemoglobin is transformed to COHb, which inhibits the release of oxygen to the tissue and thus causes tissue hypoxia.<sup>9</sup> Typical symptoms can include headache, dizziness, syncope, shortness of breath, and nonspecific neurologic complaints. With the patient breathing room air, the half-life of COHb is 5 hours; with high-flow (ie, normobaric) oxygen, the standard treatment, the half-life diminishes to 1 hour.<sup>10</sup>

According to Uyanik et al,<sup>11</sup> a 60-minute hookah session is equivalent to smoking an entire pack of cigarettes. This finding has been corroborated through numerous studies<sup>2,4</sup> in which a higher level of carbon monoxide (as measured by parts per million) is found in the blood of hookah smokers compared with that in traditional cigarette smokers. In a single hookah session, a smoker can inhale 10 times the number of "puffs," and each "puff" can have 10 times the volume of carbon dioxide in



**Figure.** A hookah, or water pipe. Tobacco, housed in the bowl at the top, is covered with a perforated metal plate or aluminum foil. A burning piece of charcoal is placed on the plate (or foil), which heats the tobacco. Smoke then travels down the body of the hookah, into a half-filled water bowl, and through a submerged tube. Inhalation produces a vacuum, which pulls the smoke through the water and into the mouthpiece.

a conventional cigarette, which can lead to an elevated carbon monoxide level.<sup>12</sup>

Immediate treatment should be aimed at decreasing the patient's COHb level through either hyperbaric oxygen therapy or normobaric oxygen therapy. The Undersea and Hyperbaric Medical Society<sup>13</sup> recommends hyperbaric oxygen therapy for patients aged 36 years or older who were exposed to carbon monoxide for more than 24 hours or who have a COHb level exceeding 25%. It is also recommended for patients who manifest symptoms such as severe acidosis, cardiovascular dysfunction, or transient or prolonged unconsciousness. In all other cases, normobaric oxygen, the standard of treatment for patients with carbon monoxide poisoning, should be supplied by a nonrebreathing mask until the COHb level is less than 5%.<sup>14</sup>

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## CASE REPORT

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### Conclusion

Carbon monoxide poisoning is difficult for physicians to identify because of its nonspecific manifestation, especially in individuals with few or no risk factors. As the US population increases and eastern culture migrates west, however, physicians may encounter more patients with more novel exposures to carbon monoxide.

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