Tobacco Smoking Using a Waterpipe (Hookah): What You Need to Know

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Objectives
At the completion of this course, the learner should be able to:
1. Describe a waterpipe (hookah) that is used to smoke tobacco.
2. Discuss the toxicants in waterpipe smoke.
3. Discuss the toxicants that can be found in waterpipe smokers.
4. Identify 3 potential health risks of waterpipe tobacco smoking.
5. Describe why a preoperative carboxyhemoglobin test might be indicated in a patient who smokes a waterpipe.

Introduction
The lethality of tobacco cigarette smoking is well known, as are its many adverse consequences on perioperative outcome. However, tobacco cigarettes are only one of several methods in which tobacco is consumed, and failing to address explicitly the extent to which a patient engages in other tobacco use methods may have perioperative implications. In particular, smoking tobacco using a waterpipe (also called hookah, narghile, shisha) is increasing in prevalence in the United States and globally, particularly among adolescents and young adults. The goal of this AANA Journal Course is to inform anesthesia providers about waterpipe tobacco smoking (WTS). The course describes a waterpipe, who uses a waterpipe to smoke tobacco, and the toxicants found in waterpipe smoke and waterpipe smokers. Based on available evidence, there is no indication that waterpipe tobacco smoking is any less risky to patient health than cigarette smoking. Anesthesia providers should begin to assess patients for this form of tobacco use explicitly and should consider addressing it as they do cigarette smoking, with the additional precaution of presurgery carboxyhemoglobin measurement.

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air over the charcoal. The heated air, that now also contains charcoal combustion products, passes through the tobacco, and the mainstream smoke aerosol is produced. Smoke passes through the body and the water in the bowl and is carried through the hose to the user. It is important to note that the waterpipe pictured in Figure 1 and discussed herein is used to smoke tobacco products. Although the use of this device to smoke illicit drugs such as marijuana is theoretically possible, in 1 survey, only 36% of waterpipe tobacco smokers reported marijuana use, and only 10% reported using the same waterpipe for smoking marijuana and tobacco.

Users of Waterpipes

Although most often associated with the Arab world, WTS is becoming more common globally, including in the United States. Wherever it is spreading, adolescents and young adults seem to be most at risk. For example, in Lebanon, current WTS ranged from 21% to 45% in some university student populations. A survey of 1,845 students in 4 Jordanian universities in 2010 revealed current-use rates of 30% and “ever-use” rates of 56%. Data from Syrian university students paint a similar picture. When taken together with the results of surveys from countries such as Canada, Denmark, Estonia, and South Africa, these Arab-world use rates support the notion that there is a growing worldwide epidemic of WTS.

In the United States, WTS is also most often seen among young adults and adolescents. For example, among 105,000 US university students surveyed in 2008, 30.5% reported ever use of a waterpipe to smoke tobacco, and WTS was the second most commonly reported tobacco use method (cigarettes first, at 34.6%). Also, of 3,770 students from 8 universities in North Carolina surveyed in 2008, 40.3% reported ever use, and 17.4% reported current waterpipe use (compared with 46.6% ever and 24.9% current cigarette smoking). Waterpipe tobacco smoking among US adolescents is also common, and reports of WTS among middle- and high-school students are becoming more frequent. In fact, in a nationwide sample of 15,100 US 12th graders surveyed in 2010, 17% reported past-year WTS, and that percentage grew to 18.5% in 2011. Anesthesia providers who have adolescent or young adult patients are almost certainly treating waterpipe tobacco smokers.

Toxicants in Waterpipe Smoke

To understand the potential influence of waterpipe use on health, awareness of the volume of smoke inhaled is necessary. The volume of smoke inhaled during a typical 45-minute episode of waterpipe use is dramatically greater than that inhaled during a typical 5-minute episode of cigarette smoking. Several studies involving waterpipe tobacco smokers have included measurement of total puff volume and demonstrated that these smokers inhale 50 to 80 L of smoke each time they use a waterpipe. In contrast, cigarette smokers inhale about 0.5 to 0.8 L of smoke when smoking a single cigarette. Therefore, based on these cross-study comparisons, a single episode of waterpipe use involves inhaling the smoke volume equivalent to 60 to 160 cigarettes. In the only laboratory study that has measured the puff volume of people who use waterpipes and cigarettes, the volume of smoke inhaled during an episode of waterpipe episode was 61.6 L, compared with 1.1 L for a cigarette, a 56:1 ratio. Clearly, waterpipe smokers inhale a lot of smoke.

This considerable volume of smoke inhaled is dangerous, because, like cigarette smoke, the smoke from a waterpipe contains polycyclic aromatic hydrocarbons (PAHs) that cause cancer, volatile aldehydes that cause pulmonary disease, carbon monoxide that causes cardiovascular disease, and nicotine that causes dependence. Indeed, relative to the smoke from a single cigarette, the smoke from a single WTS episode contains 1.2
times the nicotine, 8 times the carbon monoxide, 3 times the nitric oxides, 4 to 15 times the acrolein, 6 to 31 times the formaldehyde, and 3 to 245 times the PAHs. (The range reflects variation across the various PAHs being measured, not measurement error.)

The amounts of these toxicants differ in waterpipe tobacco smoke compared with cigarette smoke because waterpipe tobacco is heated to half the temperature of cigarette tobacco and waterpipe smoke contains charcoal combustion products and combustion products from a variety of sweeteners and flavorings. Thus, WTS may involve inhalation of additional toxicants not found in cigarette smoke.

Toxicants in Waterpipe Smokers

In terms of user toxicant exposure, even people who inhale waterpipe tobacco smoke only occasionally may be exposed to high toxicant levels. In fact, clinical research makes clear that nicotine and carbon monoxide can be found in waterpipe smokers. In a direct comparison of waterpipe and cigarette smoking in the clinical laboratory, the total nicotine exposure during 45 minutes of waterpipe use was approximately 1.7 times greater, and carbon monoxide exposure was approximately 4 times greater than after a single cigarette (Figure 2).

Nicotine is a psychomotor stimulant that binds to acetylcholine receptors and has short- and long-term effects. In the short-term, it increases heart rate and can produce nausea or dizziness in new users and mild euphoria in experienced users. The mood effects are directly attributable to nicotine-mediated neurotransmitter release, including dopamine and serotonin. Long-term use of nicotine can produce tolerance and dependence: This latter effect makes cessation of nicotine-containing products difficult because of aversive symptoms (eg, anxiety, irritability, restlessness) that occur during abstinence periods.

Carbon monoxide has a range of deleterious effects that have bearing on perioperative care of patients. The most immediate intraoperative anesthetic concerns relate to the decrease in oxygen carriage by hemoglobin because of the more than 200-fold affinity that carbon monoxide has for hemoglobin relative to oxygen. Furthermore, carbon monoxide exerts a leftward shift of the oxyhemoglobin dissociation curve, impairing release of oxygen at the tissue level (Figure 3). That carbon monoxide reduces myocardial oxygen tension is well known, a result of several mechanisms, including the following: (1) decreased myocardial oxygen extraction, (2) decreased capillary oxygen tension because of the unfavorable shift in the oxyhemoglobin dissociation curve, and (3) the associated increase in ventricular work and oxygen demand secondary to adrenergic stimulation.

It is important to note that carbon monoxide exposure is highly correlated with the toxicant content of the smoke, suggesting that when users are exposed
Health Effects of Waterpipe Tobacco Smoking

Waterpipe tobacco smoking presents at least one acute health risk and many that are longer term. The acute risk is carbon monoxide intoxication.38-41 Effects of waterpipe–induced carbon monoxide intoxication include dizziness, emesis, headache, nausea, syncope, and vertigo; carboxyhemoglobin levels of 15% to 28% have been reported. Treatment includes oxygen supplementation and, following this, symptoms resolve. The longer-term risks associated with WTS are less well understood because of the lack of resources available for the last several decades to study the issue. Nevertheless, a growing body of evidence suggests that WTS is associated with several of the diseases in which cigarette smoking has been implicated, including tobacco/nicotine dependence, lung cancer, respiratory disease, low birth weight, and periodontal disease.43,44 Unfortunately, much more work is needed to understand all of the health risks of WTS, and, at present, no research addresses the influence of WTS on perioperative outcome.

Anesthetic Implications of Waterpipe Tobacco Smoking

There is no question that patients who are current cigarette smokers are at risk for a variety of adverse perioperative outcomes.2,45 For this reason, anesthesia providers routinely determine the cigarette smoking status of patients.46 The recent increased prevalence of WTS globally, including in the United States, suggests that anesthesia providers also should assess patients regarding this method of tobacco use.

Assessment for waterpipe tobacco use should include asking specifically about the waterpipe using its various names (eg, arghile, hookah, narghile, shisha) because waterpipe tobacco smokers may interpret “Are you a smoker?” to refer to cigarette smoking only, and, thus, respond in the negative. Once a waterpipe tobacco smoker is identified, the person should, at the least, be treated in the same manner as a cigarette smoker with regard to perioperative care. However, the large volume of smoke inhaled during WTS and the concomitant high carboxyhemoglobin levels observed (15%-28%) suggest that patients who use a waterpipe may require special attention. Indeed, one case report of a patient who engaged in WTS several hours before surgery described a high level of intraoperative carboxyhemoglobin that was underestimated using conventional pulse oximetry and highlighted the need for particular care in providing anesthesia for waterpipe tobacco smokers.47

Pulse oximeters in common use in the operating room measure tissue light transmission with 2 wavelengths (2 colors) to approximate arterial hemoglobin saturation. Given that only 2 wavelengths are used, these oximeters discriminate between only 2 absorbers in the blood: oxygenated and reduced hemoglobin. Other light absorbers, namely carboxyhemoglobin, will invalidate any displayed measurement because conventional noninvasive oximeters will interpret carboxyhemoglobin as though it were composed of approximately 90% oxyhemoglobin and 10% reduced hemoglobin. In one carefully conducted study of oximetry, carboxyhemoglobin levels up to 70% were displayed as an oxyhemoglobin saturation of 92%.48 New-generation oximeters that can measure carboxyhemoglobin and other hemoglobin contaminants (methemoglobin) are available and are undergoing point-of-care evaluation. In general, explicit measurement of carboxyhemoglobin via venous blood sample on the day of surgery may be a wise precaution for a waterpipe-smoking patient.47

Cigarette abstinence for 3 to 8 weeks before surgery can reduce postoperative complications,49 but tobacco and nicotine dependence make this goal difficult. The fact that WTS can produce dependence in regular waterpipe smokers suggests that preoperative WTS cessation, while highly advisable, may pose similar challenges. Regrettably, waterpipe–specific interventions are only now being developed,50 so clinicians may need to use their best judgment regarding smoking cessation pharmacotherapy (eg, nicotine replacement medications) for waterpipe tobacco smokers.

Conclusion

Waterpipe tobacco smoking is gaining popularity in the United States, particularly among adolescents and young adults. There is no indication that WTS is any less risky to health than cigarette smoking. Anesthesia providers, in addition to routine assessment about cigarette and other forms of tobacco use, should begin to assess patients for this form of tobacco use explicitly and should consider addressing it in their anesthesia plan as they do cigarette smoking, with the additional precaution of preoperative carboxyhemoglobin measurement.

REFERENCES


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