

## REVIEW ARTICLE

# Water Pipes and E-cigarettes : New Faces of an Ancient Enemy

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### Abstract

In a world grappling with tobacco addiction, the hookah (water-pipe) and the electronic cigarette (e-cigarette) are creating new problems. Apart from posing the inherent danger of nicotine addiction, they both seem to be wolves cloaked in the sheep-skin of consumer-perceived safety, at least in comparison to the cigarette. However it seems that the e-cigarette may have a role in a nicotine-replacement therapy. There has been a wave of interest around the world in analysing these phenomena. The following review discusses the current data regarding the hookah and the e-cigarette. A PubMed, Medline and Google search using the keywords 'sheesha', 'hookah', 'water-pipe', 'electronic cigarette', 'e-cigarette', 'vapers' was carried out. The studies carried out between 2007-2013 were included in this review. Information available in the public domain on internet websites was included to study the perception of the lay consumer regarding the hookah and the e-cigarette.

The modern smoker has a lot to choose from. In the following discussion we shall look at two separate devices used for tobacco-smoking: the water-pipe (traditionally known as the hookah, sheesha or the narghile), and the electronic cigarette (popularly known as the "e-cigarette"). Though disparate with respect to their times of origin, together the water-pipe and the e-cigarette reflect the on-going fascination of youth with tobacco-smoking. To tackle these issues, the health care provider needs to be armed with sound knowledge regarding the behavioural and pathophysiological aspects of both water-pipe smoking (WPS) and the e-cigarette.

### Water Pipe Smoking

#### Structure of the Water-pipe

The water-pipe consists of the basic components listed in Table 1.<sup>1</sup>

The water-pipe is essentially a system which enables tobacco smoke to bubble through a water chamber before being inhaled through a pipe. This is popularly believed to purify the smoke. Flavouring agents like honey or molasses are

commonly added and charcoal is used for burning the tobacco.<sup>1</sup>

#### The water-pipe smoke

A comparison of the toxicant exposure of hookah and cigarette smoke was carried out in controlled settings.<sup>2</sup> The mean total puff volume for the hookah at 48.6 litres greatly exceeded that of the cigarette at one litre, thus demonstrating a significantly higher smoke exposure ( $p < 0.001$ ) with the hookah. Carbon monoxide exposure was greater with the hookah, while nicotine exposure was found to be the same. Another study<sup>3</sup> looked at the constituents of

**Table 1 : Structure of a waterpipe**

Component	Function
Bowl	Holds the tobacco and flavouring agents
Hose Tube	For drawing the smoke
Body of water-pipe with valve and gasket	Directs smoke through water-jar, rather than directly through the hose
Water jar	Smoke passes through it and gains moisture
Plate	To hold coal used for burning tobacco

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(side-stream) hookah smoke, comparing them to those of cigarette smoke. It was found that hookah side-stream smoke from a single session contains four times the amount of carcinogenic polycyclic aromatic hydrocarbons, four times the volatile aldehydes and 30 times the carbon monoxide compared to that from a single cigarette. The generation of ambient carcinogens and toxicants per session of hookah was comparable to that of smoking 2 to 10 cigarettes per hour depending upon the constituent compound. This study recommended that hookah-smoking be included under the ban on smoking in public. In a study from Virginia,<sup>4</sup> it was found that : The PM(2.5) concentrations observed among the waterpipe cafés sampled here indicated air quality in the waterpipe café smoking rooms was worse than restaurant rooms in which cigarette smoking was permitted Tobacco-free water-pipes are also being marketed as 'safe' products. However, smoke from such waterpipe preparations contained substantial quantities of toxicants. Nicotine yield was the only outcome that differed significantly between different water-pipe preparations. These findings are contrary to the depiction of "herbal" non-tobacco water-pipe preparations as safe.<sup>5</sup> A more recent study<sup>45</sup> has shown that waterpipe smoke causes greater exposure to benzene and high molecular weight polycyclic aromatic hydrocarbons, than does cigarette smoke; but causes lesser exposure to tobacco-related nitrosamines. Benzene use was correlated with a greater chance of leukaemia, as per this study.

#### **The water-pipe smoker**

"Cigarettes are for nervous people, competitive people, people on the run. When you smoke a narghile, you have time to think. It teaches you patience and tolerance, and gives you an appreciation of good company. Narghile smokers have a much more balanced approach to life than cigarette smokers." This is a quote from a popular hookah-user website<sup>6</sup> and it succinctly summarises the approach of the water-pipe smoker. The "hookah" has been a historical symbol of prestige since the Mughal era and remains very much in use in India, the Middle East and Africa, while attracting attention in the West. Interestingly in the USA, hookah-parlours seem to be exempt from certain indoor air quality legislations, with about 20-40% of college students having used the hookah.<sup>7</sup> Younger age, female sex, contact with a family member who smokes the water-pipe, Asian descent, the allure of group behaviour, lack of adequate health-warnings and the perception of 'less harm' have all been identified as risk factors for hookah addiction.<sup>8,9,43</sup> There is a general lack of awareness regarding the risks of hookah smoking, and in one study of 235 users, 58.3% believed hookah to be less harmful than cigarettes. So powerful was this perception that there

were no health-warnings issued regarding hazards of hookah use, in the setting of this study. There are several reports of pregnant women using the water-pipe, in the Middle-East.<sup>10</sup>

#### **Health hazards of WPS**

The health hazards associated with hookah smoking include addiction, carbon monoxide poisoning, lung cancer, prostate cancer and oesophageal cancer.<sup>8</sup> A recent meta-analysis<sup>11</sup> compared the lung function of smokers and non-smokers individually with water-pipe smokers: there was no statistical significance between the decline in lung function caused by cigarette and water-pipe smoking. However there was a statistically significant reduction in the lung function of water-pipe smokers compared to that of non-smokers. It was concluded that water-pipe smoking could be an important risk factor for causation of COPD. It has also been found that the prevalence of chronic bronchitis in Indians who smoke the hookah (85/1000 population) is greater than that in beedi-smokers (31/1000 population). A study from Kashmir, where hookah smoking is common, found a six-fold higher risk in hookah smokers when compared to non-smoking controls.<sup>12,13</sup> Additionally, WPS has been found to have genotoxic potential.<sup>14</sup> A recent study from Israel<sup>1</sup> examined the acute effects of hookah smoking on cardiac and respiratory parameters. It was found that after a 30 minute session of hookah-smoking there were significant increases in blood-pressure (systolic and diastolic), heart rate and respiratory rate. This has been attributed to the action of nicotine in hookah smoke. There was also a decline in peak expiratory and mid-expiratory airflow rates. A significant rise on blood carboxyhaemoglobin (COHb) concentration was also noted although FEV1 and FVC did not show changes. There was a reduced concentration of fractional exhaled nitric oxide, but the clinical significance was questioned. There have been reports of increased COHb concentrations necessitating hospital admission after hookah smoking.<sup>15</sup> It is foreseeable that sharing of the hookah equipment by multiple users in an overcrowded, poorly ventilated area can lead to the spread of respiratory infections, especially tuberculosis. Water-pipe smoking has also been discovered to be a risk factor for gastric carcinogenesis.<sup>31</sup>

It also stands to reason that continued tobacco exposure in the form of the water-pipe may thwart efforts to quit cigarette smoking. A Cochrane review in 2007<sup>16</sup> concluded that more randomised studies are needed to further elucidate the exact health hazards of the hookah, and for development of effective strategies to treat hookah addiction.

#### **Legal Issues**

Permits need to be obtained for opening a sheesha-

bar, and conduction of police-raids on illegal outlets has been reported in popular media.<sup>44</sup> Numerous states, for example Karnataka, Haryana, Rajasthan and Maharashtra have banned hookah-parlours.<sup>33</sup> The cigarettes and other tobacco products Act<sup>32</sup> of 2003 is the law which covers the sale of cigarettes and other tobacco products. Flagrant flouting of these laws in the form of sale of tobacco products near schools has also been reported.<sup>34</sup> Sometimes, the hookah may be devoid of tobacco whilst still retaining other harmful components, and thereby fall out of the scope of the law. However police have been known to raid “non-tobacco” hookah parlours as well.<sup>35</sup> One can hope that strict enforcement of anti-tobacco laws will be more and more common. Positive respiratory outcomes of such law enforcement have been reported in the form on decreased acute asthma admissions in a study from the UK.<sup>36</sup>

### **The Electronic Cigarette (The e-cigarette)**

Another new phenomenon is the E-cigarette,<sup>17</sup> which is a form of an ENDS (electronic nicotine delivery system). These are battery-driven devices with glowing diode tips that emit mist. E-cigarettes contain nicotine cartridges with airflow sensors, but do not burn tobacco. They are therefore advertised as environment friendly and are even marketed to adolescents in the West. E-cigarettes or “e-cigs” or ENDS, are increasingly becoming available in India. The prefix ‘E’ stands for ‘electronic’, which is apt, considering their mechanism and the fact that they can be bought using e-mail.<sup>18</sup> An ENDS-user is known as a “vaper”.<sup>19</sup>

#### **Content of the vapouriser fluid**

Although the manufacturers claim that the particulates generated by an E-cigarette are too small to be deposited in the alveoli, their carcinogen content still includes the following: nitrosamines, di-ethylene glycol, acetaldehyde, and other toxins like mercury, anabasine, myosmine and beta-nicotyrine. These devices deliver nicotine to the blood faster than do nicotine inhalers.<sup>17,18</sup> Studies have shown variability in various brands of e-cigarettes with respect to parameters of aerosol production and inspiratory flow rates required to generate an adequate puff volume. This probably reflects a lack of regulation of quality control in e-cigarette production.<sup>20</sup> In the UK, a study<sup>37</sup> the actual nicotine content of the e-cigarette liquid corresponds closely to that depicted on the container of the same. However, impurities like tin, nickel, copper, aluminium and silicate particles have been found as contaminants in e-cigarette cartomiser fluid and aerosols, in another study.<sup>38</sup> One study has shown that the vapour of e-cigarettes is significantly less cytotoxic than that of cigarettes in a study on cultured mammalian fibroblasts.<sup>39</sup> The quality of the e-cigarette fluids available in India should be analysed.

### **Popular perceptions of the electronic cigarettes: can it be a potential anti-smoking tool?**

In an electronic survey<sup>17</sup> of ENDS users: the most commonly reported benefits of these devices were less dyspnoea on exertion compared to regular cigarettes, less cough, less expectoration and less sore throat. These devices were also permissible in the smoke-free environments. In this survey<sup>17</sup> of 104 experienced e-cigarette users, it was found that about 75% started using e-cigarettes with the intention to quit smoking. The vapers typically used a medium or high concentration nicotine liquid (13 mg or more) and desired devices that produced hotter and more intense vapours. However, the commonly reported disadvantages<sup>15</sup> of these devices were that they were difficult to refill, the cartridges could leak and that dose adjustment was difficult. This last could be an important problem, given that each cartridge may contain up to 1000 mg of nicotine, with the fatal dose for adults being 30 – 60 mg. A small survey<sup>19</sup> of 15 vapers concluded that they perceived many benefits of ENDS versus conventional cigarettes, such as improved taste, smell, exercise tolerance, availability of ‘modifications’ and a reduced nicotine-dependence. Thus, although scientific reports urge caution before labelling e-cigarettes as beneficial,<sup>21,22</sup> vapers continue to perceive them as so.<sup>23</sup>

In another online survey,<sup>24</sup> 3587 participants were given an online questionnaire, of which 70% were former tobacco smokers, and had used the e-cigarette for a median duration of 3 months, with about 5 refills per day. Nearly 92-96% participants found the e-cigarette useful for quitting smoking. Around 80% participants felt that the e-cigarette was less toxic and would reduce cravings for tobacco. About 40% used it to circumvent anti-smoking regulations. A significant proportion felt that they would restart smoking if they quit e-cigarettes. This survey concluded that the popular perception of the e-cigarette is that of a safer and more acceptable alternative to smoking cigarettes, and was also used by the participants like they would use a nicotine-replacement system to quit smoking. Thus there is a growing interest in the use of the ENDS as a smoking-cessation tool.

A recent 6 month pilot study<sup>25</sup> involving 40 current smokers looked at the effect of the e-cigarette on smoking cessation and found that 55% of the participants achieved 50% reduction and abstinence, and no significant side-effects were seen in smokers intending to quit. However a large survey<sup>26</sup> of more than 10,000 American adults did not show any specific intent on the part of e-cigarette users to quit smoking and also showed an exponential increase in the awareness regarding ENDS among Americans. An interesting study of YouTube<sup>27</sup> videos depicting ENDS users found that the male to female ratio was 5:1. ENDS users had significantly longer puff-duration

(4.3 seconds) than did conventional smokers (2.4 seconds). This apparently helped compensate for the poor nicotine delivery by the ENDS.

The addiction potential of the ENDS was examined in a study<sup>28</sup> of 20 current cigarette smokers. It was found that ENDS deliver clinically significant amounts of nicotine, enough to reduce cravings for cigarettes. It was noted that ENDS seem to have a lower addiction potential, but this requires further study. In South Korea,<sup>29</sup> the increase in the number of e-cigarette users has paralleled the public movement toward cigarette-smoking cessation. It has also been noted that many vapers purchase ENDS in order to escape disciplinary action for smoking in smoke-free zones, and end up with dual cigarette and ENDS use, which may be more harmful than using either device alone.

In one study,<sup>40</sup> 1347 smokers across 33 countries responded to an online questionnaire regarding a particular brand on an e-cigarette and the refill liquid. Upon commencement of the e-cigarette, 74% reported not smoking for several weeks and 70% reported reduced urges for cigarette smoking. They also reported improved breathing, and reduction in coughing and craving.

A randomised controlled trial<sup>41</sup> (Efficiency and Safety of an electronic cigarette as a cigarette substitute or 'ECLAT') was carried out in Italy. It evaluated smoking reduction/abstinence in 300 smokers (not intending to quit). They were divided into three groups, in which two were given different strengths of nicotine in their e-cigarettes of the same e-cigarette brand while the third group was placebo. Subjects were monitored at 12 and 52 weeks of use, and smoking abstinence was noted in 10-22% of patients, while overall 8.7% patients reported complete abstinence from smoking at the end of 52 weeks.

The multiple studies mentioned above have certainly shown that electronic cigarettes are perceived to be safer than regular cigarettes by the public and that they may have potential for use as an anti-smoking device. However, all the authors have urged further study prior to formal recruitment of this tool in the anti-smoking armamentarium.

E-cigarettes are banned in Brazil, Norway and Singapore.<sup>42</sup> The United Kingdom has sought to regulate the use of the e-cigarette as medicine, recognising its possible use for patients desiring to quit smoking.<sup>42</sup> In fact, the WHO recommended a ban<sup>30</sup> on disseminating information that suggest that electronic nicotine vapourisers are safer than cigarettes, or that they are an effective way of combating nicotine addiction, until appropriate evidence can be provided. According to the WHO recommendations, references to efficacy of electronic vapourisers for quitting smoking or to their health effects must be backed

by reliable pharmacokinetic studies, safety and efficacy tests and should be certified as such by the regulatory agencies.<sup>30</sup> Hence, the perceived benefits of the 'e-cigarette' as an anti-smoking device need to be carefully weighed against the proven dangers of nicotine addiction and the relatively unknown long term adverse effects of ENDS use.

### Authors' Conclusion

Tobacco addiction seems to have taken a vice-like grip on Indian youth. For an individual, smoking starts out as a socio-cultural<sup>46</sup> phenomenon, standing on the classical pillars of peer pressure, enjoyment and group behaviour; eventually metamorphosing into a health issue, now based on addiction and systemic adverse effects of nicotine and carbon monoxide, among other chemical carcinogens. While judicial notice of this problem is being taken in the form of smoking bans, sadly hookahs and e-cigarettes seem to have received social sanction. These problems need to be analysed further in the Indian context. A lack of general awareness regarding the harmful effects of hookahs and e-cigarettes should probably prompt the physician to take an initiative in patient education, while the possibility of the use of the e-cigarette as an anti-smoking device should be explored with due diligence.

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