Breath Carbon Monoxide Levels in Different Forms of Smoking

Sheetu Singh, Soumya M, Anirudh Saini, Varun Mittal, Uday Veer Singh and Virendra Singh

Pulmonary Division, SMS Medical College and Asthma Bhavan, Jaipur, India

ABSTRACT

Background and Objectives. Bidi, cigarette, hookah and chillum are common modes of tobacco smoking in India. Many people consider hookah and chillum smoking less toxic because smoke is filtered through water or wet cloth. We evaluated the toxicity of tobacco smoking by measuring end-tidal carbon monoxide (eCO) levels after various modes of smoking.

Methods. Eighteen healthy smokers who smoked bidi, cigarette, hookah and chillum on six days were studied. They smoked one bidi, one cigarette, five minutes hookah, one serve (15 minutes) hookah, five minutes chillum and one serve (15 minutes) chillum on six days randomly. The eCO values were measured before initiation of smoking and for a period of one hour after the smoking session. Increase in eCO values in comparison to baseline after different modes of smoking was compared.

Results. In comparison to baseline, mean eCO levels were raised by 4.94 (0.96) parts per million (ppm) immediately and 4.17 (1.07) ppm 60 minutes after cigarette smoking. Bidi smoking caused slightly less increase in mean eCO levels (3.17 (0.82)). One serve of hookah and chillum smoking caused elevation of mean eCO values by almost eight-folds higher than that of cigarette smoking. Five minutes of smoking with hookah (22.18 [5.29]) and one serve of hookah (33.0 [8.76]) and chillum (40.14 [12.73]) caused significantly higher values of mean increase in eCO in comparison to cigarette smoking (p<0.001).

Conclusion. With regard to eCO levels, hookah and chillum smoking are much more toxic than cigarette smoking.


Key words: Hookah, Tobacco smoking, Bidi smoking, Chillum smoking, End-tidal carbon monoxide.

INTRODUCTION

Bidi, cigarette, chillum and hookah are commonly used methods of smoking in India.1 Amongst them, bidi is the most common form of tobacco smoking (50%).1 Less than 20% smoke cigarettes, whereas, hookah smokers are even lesser. A bidi is made of a piece of tendu (Diospyros melanoxylon) leaf in which dried tobacco is rolled. Primarily it is popular in the adults but now flavoured bidis (chocolate, mango, cherry) are also in vogue.2 They are freely available on the net and are a tempting attraction for children.2 Chillum consists of a clay pipe 10cm-15cm long that is held vertically. They are locally made and are inexpensive. The smoke passes through a fold of wet cloth before getting inhaled. Chillum has also been used to smoke opium and other narcotic substances. Hookah is also called as water-pipe, narghille and sheesha in different parts of the world. The tobacco smoke in a hookah passes through water before inhalation. Chillum and hookah are mainly smoked in rural areas. However, now these are becoming popular amongst youngsters in metropolitan cities because of availability of hookah joints. Hookah is becoming a popular way of smoking tobacco not only in India, but also in many countries in the world. In a recently carried out study in United States of America (USA), it was found that 15% of college students have used hookah at least once in life time which was much more than any other substance of abuse.3

As the smoke in hookah is filtered through water and in chillum it passes through a wet cloth, many smokers consider these modes of smoking to be less harmful. Though data are available to show harmful effects of cigarette smoking, more convincing comparative data are needed, especially for less conventional modes of tobacco smoking, such as bidi, hookah and chillum. We planned to study levels of carbon monoxide in exhaled breath after use of hookah, bidi and chillum in comparison to cigarette smoking.

MATERIAL AND METHODS

Eighteen healthy smokers were included in the study after obtaining the informed consent. The study was approved by Institutional Ethics Committee. All subjects were familiar and have been using all the...
four modes of smoking; however, routinely they were using one particular mode of smoking. The subjects reported to the respiratory laboratory after abstaining from any smoking for 24 hours. The eCO levels were measured using a breath analyser (Bedfont UK) at baseline and for one hour after using different modes of smoking on six days. Subjects smoked one bidi, one regular cigarette, hookah for five minutes, one serve hookah (15 minutes), chillum for five minutes and one serve of chillum (15 minutes) on six days randomly. Usually, a smoker takes five minutes in smoking a cigarette. Therefore, to have comparable data for same duration we also studied hookah and chillum smoked for five minutes. Chillum and hookah were used on two days with two types of serving. After obtaining baseline values, eCO levels were determined immediately, 10 minutes, 20 minutes, 30 minutes and 60 minutes after completion of smoking. The same volunteers were evaluated on subsequent days with random allocation of smoking modes.

Increase in end-tidal carbon monoxide values from baseline (ΔeCO) were calculated after different modes of smoking. The mean ΔeCO values among various modalities of smoking were compared by application of analysis of variance.

RESULTS

The mean age of volunteers was 48.0±11.0 years. At baseline eCO levels in different groups, such as bidi, cigarette, hookah (5 minutes), hookah (one serve), chillum (5 minutes) and chillum (one serve) were 10.2±3.2, 10.4±4.2, 12.1±5.6, 11.7±5.6, 10.7±4.2 and 10.7±4.2 ppm, respectively (Table). The baseline values on different days were comparable (F=0.496, p=0.778). The eCO values were increased from baseline values with different modes of smoking (Figure). It was observed that one serve of chillum raised the eCO levels maximally. One serve and five minutes of hookah smoking also raised the eCO levels significantly higher in comparison to cigarette smoking (p<0.001). Bidi smoking also caused increased levels of eCO and the magnitude of increase was slightly less than that of cigarette but the difference was not significant statistically.

| Pre-smoking mean baseline and post-smoking increase in eCO (Δ) values after various modes of smoking |
|---------------------------------|-------------|-------------|-------------|-------------|-------------|
| **Pre-smoking eCO Values (ppm)** | At the end of smoking | 10 min after smoking | 20 min after smoking | 30 min after smoking | 60 min after smoking |
| Bidi | 10.2±3.2 | 3.00±0.72 | 3.61±0.84 | 3.67±0.86 | 3.61±0.83 | 3.17±0.82 |
| Cigarette | 10.4±4.2 | 4.94±1.07 | 4.56±0.91 | 4.89±1.07 | 4.67±0.99 | 4.17±0.96 |
| Hookah (5 min) | 12.1±5.6 | 25.27±6.30* | 25.09±6.32* | 23.45±5.61* | 23.55±5.43* | 22.18±5.29* |
| Hookah (One serve) | 11.7±5.6 | 41.57±11.23* | 42.57±10.22* | 39.14±9.69* | 39.00±10.20* | 33.00±8.76* |
| Chillum (5 min) | 10.7±4.2 | 5.55±0.79 | 4.64±0.65 | 5.18±0.66 | 5.00±0.61 | 4.27±0.48 |
| Chillum (One serve) | 10.7±4.2 | 45.00±17.04* | 46.14±14.41* | 41.29±11.72* | 39.86±11.82* | 40.14±12.73* |

DISCUSSION

Cigarette smoke consists of around 2% to 4% carbon monoxide. Our study showed that bidi smoke also raised eCO level comparable to cigarette smoking. Both hookah and chillum raised eCO much higher levels than cigarette smoking. The level of eCO

One serve is equivalent to 15 minutes of smoking
*expressed as mean±SD; **expressed as mean±(SEM); * P<0.001;
ppm=Parts per million; SD=Standard deviation; SEM=Standard error of mean.
remained high for one hour. Clinical significance of such levels of eCO is yet not known but in animal experiments even low levels of CO have been shown harmful.5

It has been a popular myth that the water in a hookah detoxifies the smoke. Old historical accounts state that the hookah was invented by a physician named Hakim Abul Fath during the reign of Emperor Akbar in India.6 The physicist suggested that this form would be less toxic. So this popular belief of hookah being safe is as old as the origin of hookah. It had been shown in older studies that hookah smoking was less toxic as compared to cigarette smoking because in it smoke was passed through water.7 However, a study done in Pakistan8 showed that the eCO hazard is similar in hookah and cigarette smokers. It was also substantiated in another study carried out by Shafagoj and Mohammed.9 They documented an increase in end-expiratory increase in eCO, heart rate, systolic, diastolic and mean arterial blood pressure after hookah smoking. In this study,9 it has been suggested that eCO levels were comparable to cigarette smoking, Since they did not measure comparative eCO values after hookah and cigarette smoking, objective data were lacking.

Our study showed that eCO levels after hookah smoking was much higher than cigarette smoking, therefore, suggesting substantial higher toxicity than cigarette smoking. A newer study9 has also suggested that hookah smoke is more toxic in terms of CO and smoke exposure.8

Hookah joints claim that the nicotine content is 0.5% while tar content is 0%.11 Hookah smokers continue smoking till they have enough nicotine to satisfy them. Hookah smoke is made less irritating by moisturising it and adding fruity flavours. Thus, hookah smokers inhale more smoke and are exposed to higher levels of CO, carcinogens and heavy metals present in hookah smoke.9 This exposes water-pipe smokers to the risk of same kind of diseases as caused by cigarette smoking which includes cancer, heart and respiratory diseases.12 The concentration of toxins inhaled during hookah smoking depends on the frequency, depth of inhalation and total duration of the smoking session.12

Bidi is a slim, unfiltered and a more dangerous form of tobacco. Some studies indicate that the amount of nicotine and other toxic substances delivered by a bidi is as great as that by an ordinary cigarette.13,14 In a recent study,15 the average breath CO levels were equal to or higher for bidi smokers than cigarette smokers. However in our study, eCO levels were slightly lower during bidi than cigarette smoking. Use of bidi is not limited to rural India but even in USA as many as 5% adolescents use bidi believing that they are healthy alternatives to traditional cigarettes.16 The irony of bidi smoking is that it is smoked with more intensity and frequency leading to higher nicotine intake14 and 2-3 times greater tar inhalation than cigarettes.17

One serve of chillum smoking was found most toxic in increasing eCO levels in the breath. Though chillum smoking is not widely practiced in urban areas but many people in rural India still smoke chillum. Since smoke through chillum passes through wet cloth many people believe it less toxic. Unfortunately, none of the studies in the past evaluated the toxic effects of chillum. In view of the results of the present study showing highest eCO levels after chillum smoking, there is need to study the effect of this mode of smoking more extensively. Curiously five minutes of chillum smoking could increase eCO level much less than five minutes hookah and one serve of chillum smoking. Probably it may due to the fact that chillum takes longer time in ignition and smoke generation.

CONCLUSIONS

Bidi, the most commonly used mode of smoking, is as toxic as a regular cigarette in terms of end-tidal CO levels. Hookah and chillum use commonly considered harmless were associated with almost eight-fold higher rise in breath CO levels in comparison to cigarette smoking, indicating substantially higher toxicity. One serve of chillum smoking lead to maximal increase in eCO levels indicating the possibility of chillum being the most dangerous mode of smoking.

REFERENCES


