



Hooked on hookah: Severe carbon monoxide poisoning in water-pipe users.

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Abstract

INTRODUCTION: The water pipe (hookah) as a method of smoking tobacco and other substances is gaining popularity both in the US and worldwide.¹ In the past 5 years there have been numerous reports of serious carbon monoxide (CO) poisoning after smoking from a hookah. A possible cause of increased incidence is the use of ‘quick-light’ coals to fuel the device. In this study we report the case of a 40 year hookah smoker who presented to our hospital following first time use of quick-light coals. We performed a comparative study under laboratory conditions of natural wood versus quick-light charcoal and CO production. We found that quick-light coal produces significantly higher levels of CO than natural wood coal during a typical smoking session. **METHODS:** A medium sized hookah was assembled with the water-pipe hose attached to an activated charcoal filter. A single 11 gram tablet of either natural wood or quick-light charcoal was placed atop an 18-hole perforated aluminum foil barrier and ignited. A 3 liter calibrated syringe was used to withdraw 600 ml of smoke from the hookah apparatus, diluted with 2.4 liters of air and equilibrated in a 3 liter dilution bag. Dilution bag contents were analyzed by a calibrated CO-meter (Bacharach 0-2000ppm). Samples were drawn every 3 minutes during a total run time of 90 minutes. Coal core temperatures were measured (°C) using a laser thermometer at each 3 minute time point. All measurements were done in triplicate and group data were analyzed by two-way repeated measures ANOVA using a p-value less than 0.05 as statistically significant. **RESULTS:** Natural wood charcoal produced a maximum CO level of 2060 ppm ± 64 ppm whereas quick-light coals produced a peak CO of 6885 ± 1074 ppm. Over a 90 minute smoking session, quick-light coals produced significantly more CO than natural wood (p<0.0001). **CONCLUSION:** Quick-light charcoal produces significantly more carbon monoxide than natural wood charcoal over a 90 minute smoking period. The ease of use and availability of quick-light coals may in part contribute to the increased incidence and severity of carbon monoxide poisoning in hookah smokers presenting to the emergency department.

Background

- ❖ The water pipe (hookah) has been in use as a method of smoking tobacco and other substances over the past four centuries.
- ❖ Today it is gaining widespread popularity worldwide and in the US at hookah lounges.
- ❖ Hookah smoking is widely perceived as ‘safer’ than other forms of tobacco
- ❖ Recent popularity of ‘quick-light’ coals to fuel hookah may be associated with increases in the rate of serious CO poisoning presenting to hospital within the past 5 years.
- ❖ In this study we aim to do the following: report a case of hookah-related CO poisoning; conduct a literature review; measure the CO output of hookah using natural wood-charcoal versus quick-light coals under laboratory conditions

Case Report

A 55 year old Middle-Eastern man with no significant medical history was transferred to our emergency department following an episode of pre-syncope. He is a lifelong, daily smoker of hookah. He uses exclusively ‘natural’ wood-charcoal obtained from a local market. The night of admission he purchased quick-light hookah coals after running out of wood-charcoals. This was his first use of quick-light coals which he had been using to smoke hookah at home. Smoking session was 2 to 3 hours during which he began experiencing chest tightness, dyspnea and dizziness followed by a pre-syncopal episode without loss of consciousness. After deliberating for approximately 3 hours, EMS was alerted. On EMS arrival, his CO-Hb was 29%, measured approximately 3 hours since his last smoke. He was placed on supplemental oxygen and taken to a nearby emergency room. Initial cardiac enzymes and EKG were unremarkable. The Duke Hyperbaric Service was consulted and he was transferred to Duke University Hospital for HBO₂. At the hyperbaric unit he reported headache, chest tightness and dyspnea. Family history was negative for cardiac and neurologic diseases. He did not smoke cigarettes or use recreational drugs. His presenting blood pressure was 164/110, pulse rate 72, oral temperature 36 °C (96.8 °F), respiratory rate 20bpm, room air oxygen saturation 100%. He was alert, fully oriented and cooperative. His neurological exam was positive for mild dysmetria; a positive Romberg’s test; unsteadiness of tandem gait; calculation difficulty with errors on ‘serial 7s’ test; asymmetrical clock drawing and short-term memory impairment. Venous blood gas drawn 6.5 hours following last CO exposure revealed: CO-Hb 6.8%; lactate 0.9; glucose 98. A CT brain was unremarkable. Hyperbaric oxygen started 7 hours following his last CO exposure. He received two treatments at 2.8 ATA for 85 minutes followed by 2 ATA for 120 minutes. His symptoms completely resolved following HBO₂ treatment. Calculation deficits and asymmetrical clock-drawing persisted unchanged, reportedly baseline as per his wife. Romberg’s test, dysmetria and short-term memory deficits corrected to normal.

Review

Table 1. Summary of reported cases of carbon monoxide poisoning presenting to hospital				
	Age (yr)	Sex	CO-Hb (%)	HBO ₂
Al-Moamary et al	N/A	N/A	30	N/A
Levant et al	N/A	N/A	20.8	N/A
Lim et al,2009	19	M	27.8	No
Uyanik et al, 2009	25	M	28.7	No
Cavus et al, 2010	25	M	31.1	No
La Fauci et al,2011	16	F	24	Yes
Turkmen et al, 2011	N/A	N/A	N/A	N/A
Turkmen et al, 2011	N/A	N/A	N/A	N/A
Clarke et al, 2012	30	M	15	No
Clarke et al, 2012	34	M	21	No
Clarke et al, 2012	38	M	18	No
Clarke et al, 2012	26	M	20	No
Clarke et al, 2012	21	F	18	No
Clarke et al, 2012	21	F	7.3	No
Clarke et al, 2012	31	M	23	No
Clarke et al, 2012	19	F	2	No
Clarke et al, 2012	22	F	14	No
Clarke et al, 2012	17	F	12	No
Clarke et al, 2012	18	M	25	No
Clarke et al, 2012	22	F	15	No
Ashurst et al, 2012	21	M	15.3	No
Misek et al, 2014	24	M	33.8	Yes
Our case, 2014	55	M	29	Yes

To date, 23 cases of hookah-related severe CO poisoning presenting to hospital have been reported. Mean age was 25.4 (range 16 to 55) and mean CO-Hb was 20.5% (range 2 to 33.8%). Three cases were treated with HBO₂.

Survey

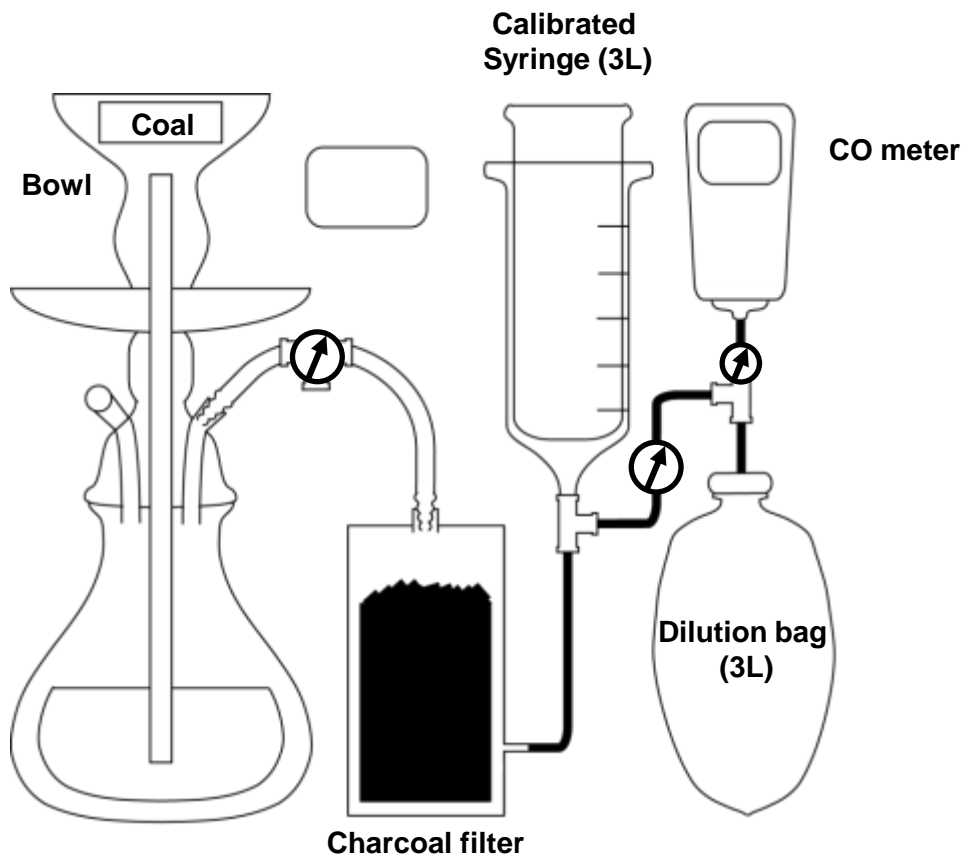
Table 2. Quick-light coals more commonly available from tobacco vendors

Coal type	Number	Percentage (%)
Natural	4	16
Quick-light	10	40
Both	11	44

Survey of regional hookah bars and tobacco vendors in the Raleigh-Durham research triangle area. Of 25 vendor responses, a significant majority sold quick-light coals. (96% survey response rate)

Study Design

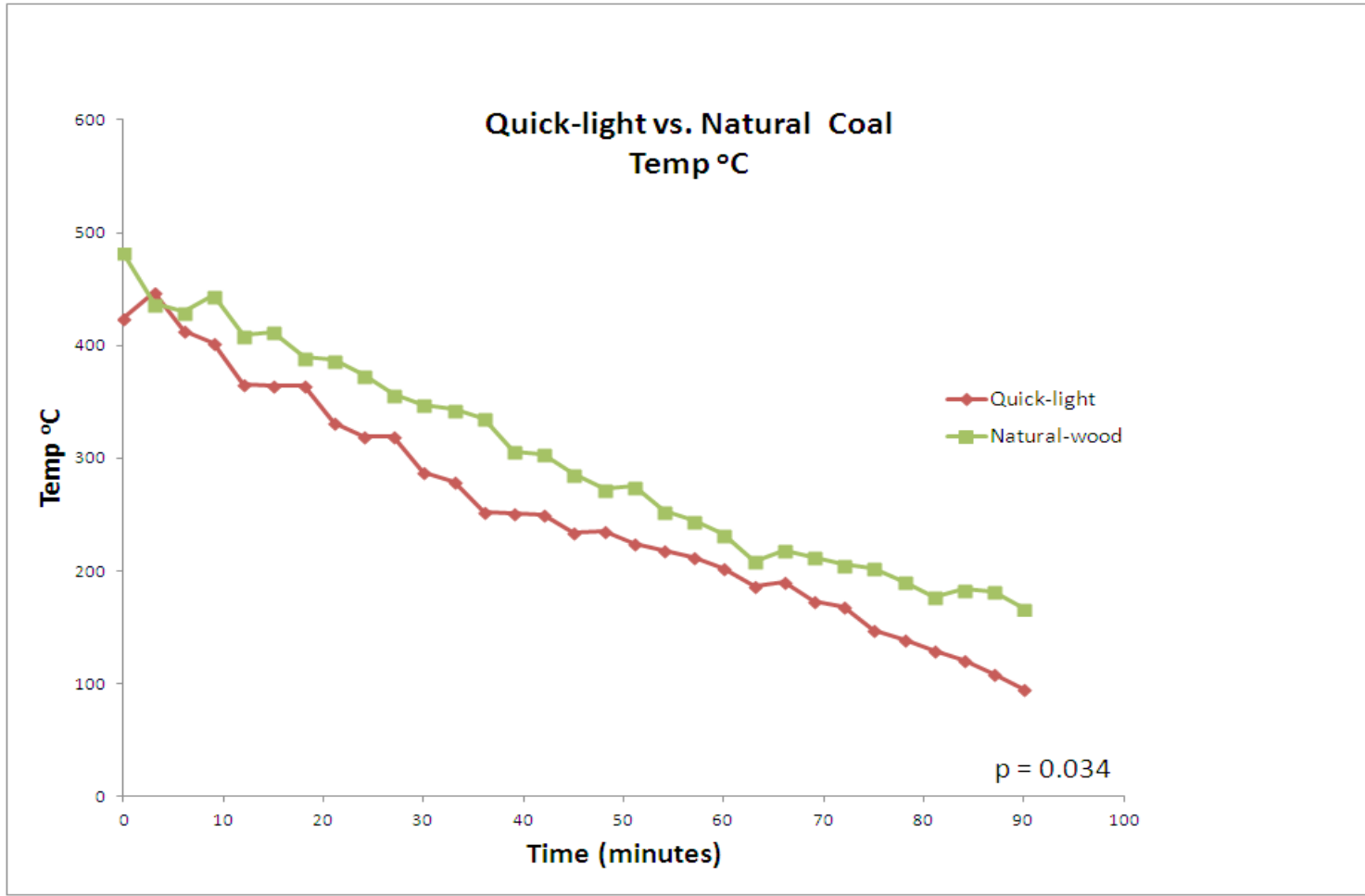
Figure 1. Hookah apparatus



Medium sized hookah assembly: Water-pipe hose attached to activated charcoal filter. Single coal tablet (natural wood or quick-light) is placed atop bowl and ignited. Three liter calibrated syringe used to withdraw smoke from hookah, diluted with air and equilibrated in 3 liter dilution bag. Bag contents analyzed by CO-meter (Bacharach 0-2000ppm). Smoke samples drawn at 3 minute intervals, total run time was 90 minutes. Measurements performed in triplicate.

Results

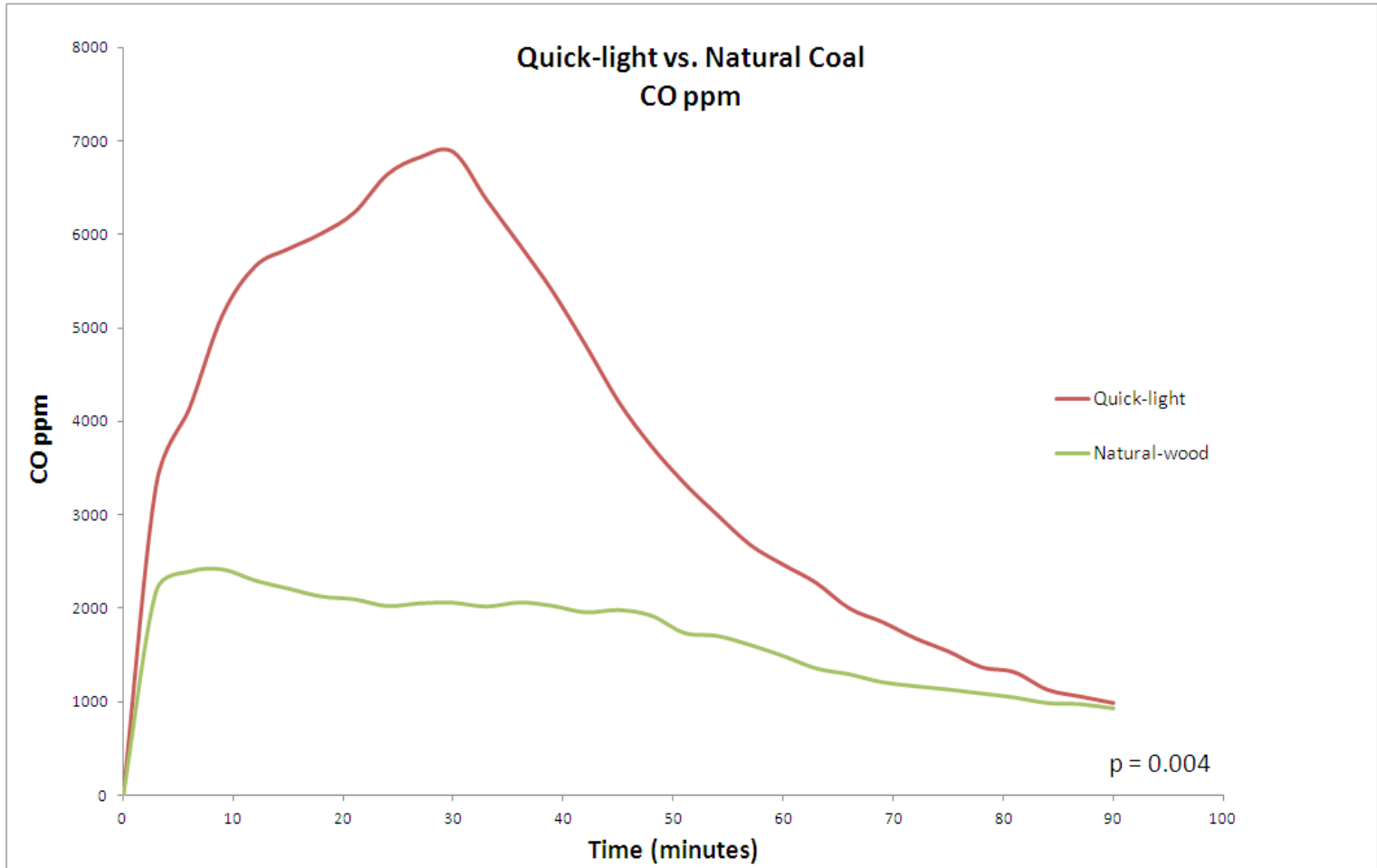
Figure 2. Natural wood coals burn at higher core temperature than quick-light coals



Charcoal core temperatures measured (°C) by laser thermometer at 3 minute intervals. Quick-light charcoal core temperatures significantly lower than natural wood charcoal over the course of a 90 minute smoking session. (P<0.05 by two-way repeated measures ANOVA).

Results

Figure 3. Quick-light coals produce more CO than natural coals in a single smoking session



Charcoal CO concentrations in ppm. Natural wood charcoal produced a maximum CO level of 2060 ppm ± 64 ppm whereas quick-light coals produced a peak CO of 6885 ± 1074 ppm. Quick-light charcoal produces significantly more than CO than natural wood charcoal over a 90 minute smoking session. (P < 0.001 by two-way repeated measures ANOVA).

Conclusions

- ❖ Over the past 5 years there has been an increase in the number of reported cases of hookah-related CO poisoning presenting to hospital
- ❖ Quick-light coals were more commonly available than natural wood charcoal in a regional survey of tobacco vendors
- ❖ Quick-light charcoal burns at a lower core temperature than natural wood charcoal
- ❖ Quick-light charcoal produces significantly more carbon monoxide than natural wood charcoal over a 90 minute smoking period
- ❖ The ease of use and availability of quick-light coals may in part contribute to the increased incidence and severity of carbon monoxide poisoning in hookah smokers presenting to hospital

References

- Rankin KV. Tex Dent J. 2011 May;128(5):441-5. (general)
- Ashurst JV et al. J Am Osteopath Assoc. 2012 Oct;112(10):686-8.
- La Fauci G et al. CJEM. 2012 Jan;14(1):57-9.
- Turkmen et al. Clin Toxicol (Phila). 2011 Aug;49(7):697-8.
- Clarke SF et al. Prehosp Disaster Med. 2012 Dec;27(6):612-4.
- Misek et al. J Med Toxicology. 2014 Epub.