

Carcinoembryonic antigen (CEA) levels in hookah smokers, cigarette smokers and non-smokers

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Abstract

Objective: To find CEA levels in smokers of different categories (hookah smokers, cigarette smokers smoking different brands of cigarettes and different number of cigarettes per day) and to correlate CEA levels with type and rate of smoking.

Methods: A total of 122 cigarette smokers (115 men and 7 women) and 14 hookah smokers (all men) with age ranging from 16-80 years were studied. CEA levels were also measured in 36 non-smokers who served as controls. Enhanced chemiluminescent immunometric technique was applied to measure CEA levels in our subjects.

Results: The mean CEA levels of cigarette smokers were compared with the mean CEA levels observed in hookah smokers (7.16 ± 10.4 ng/ml) and non-smokers (2.15 ± 0.68 ng/ml). The mean value of CEA level observed in cigarette smokers, 9.19 ± 14.9 ng/ml ($n=122$) was significantly higher than the levels in non-smokers and hookah smokers ($p < 0.0067$). It was also observed that CEA levels increased with the number of cigarettes smoked per day. The highest levels were observed in smokers who smoke more than 31 cigarettes per day. The smokers that use relatively cheaper brands of cigarettes had higher levels of CEA compared to those who use high quality brands.

Conclusion: It was concluded that the brands of cigarettes (which were ranked on the basis of price) and the rate of smoking both play an important role in raising the CEA levels. Further the common belief that hookah also called narghile or shisha is a relatively safe mode of smoking is not completely correct; a significant proportion of hookah smokers have high levels of CEA although mean levels of hookah smokers were low compared to cigarette smokers (JPMA 57:595;2007).

Introduction

Smoking is a world health problem. More than one billion people (men, 1 billion women, 250 million) smoke in the world resulting in 4.2 million annual deaths. In addition to premature aging, it causes many diseases including cancer.¹ Tobacco smoke contains over 4800 different chemicals out of which 69 are carcinogens, and

several are tumour promoters or cocarcinogens.²

The cancers related to smoking are cancers of lung, oral cavity, pharynx, larynx, oesophagus, pancreas, urinary bladder, and renal pelvis. There is also sufficient evidence for a causal association between cigarette smoking and cancers of the nasal cavities and nasal sinuses, oesophagus (adenocarcinoma), stomach, liver, kidney (renal-cell carcinoma), uterine cervix and myeloid leukaemia.³ Doll

and Peto⁴ mathematically proved that the exposure duration to tobacco smoke is much more important than the daily number of cigarettes. Quitting as early as possible remains the most powerful factor in reducing the cancer risk. Pipe and cigar smoking can also cause lung cancer, although the risk is not as high as with cigarette smoking".⁵

It has been reported that the concentration of carcinoembryonic antigen (CEA), known as a marker of malignant transformation and chronic inflammation, is increased in a variety of cancers e.g., carcinoma of pancreas⁶, uterine cancer⁷ and cancers of lung⁸ and breast⁹, and among smokers.^{10,11} Greater-than-normal values of CEA may therefore indicate the presence of cancer.

Heavy smoking over many years might also raise blood CEA levels. Most of the studies done so far are on cigarettes and pipe smokers. Effect of hookah smoking on CEA levels has not been studied in detail although hookah/shisha is now considered as an extremely important world health problem.¹² The aim of this study was to find CEA levels in smokers of different categories (hookah smokers, cigarette smokers smoking different brands of cigarettes and different number of cigarettes per day) and to correlate CEA levels with type and rate of smoking.

Subjects and Methods

Harriet Becher¹³ has classified cigarette smokers into regular smokers, occasional smokers and non-smokers. Regular smokers are defined as smokers usually smoking at least one cigarette a day. Occasional smokers are defined as smokers smoking less than one cigarette a week. Regular smokers are further classified according to the number of cigarettes they smoke: light: 5-10 cigarette/day, medium smokers: 10-20 cigarette/day and heavy smokers: 20-60 cigarette/day.

A total of 122 regular cigarette smokers (115 men, 7 women) and 14 hookah smokers (not mutually exclusive and covering the whole range) who smoked at least once daily (all men) of age ranging from 16 to 80 years were studied. Most of these volunteers (smokers) belonged to different cities of Southern Punjab. For cigarette smokers, those who smoked cigarettes only, were included and the individuals who used other modes of smoking or used bedi or even chewed tobacco were excluded. In case of hookah smokers the individuals who used mostly hookah were included. However due to difficulties in approaching the ever hookah smokers, the hookah smokers who occasionally used cigarettes were also included in the study. Further they were also examined to exclude any illness. The subjects were individually approached by the researchers and belonged mostly to urban areas of Multan district. Depending on the rate of smoking (number of cigarettes

smoked per day) the cigarette smokers were divided into five groups. The number of cigarettes smoked per day ranged from 3-60 cigarettes per day (8-48 packets/year). The cigarette smokers used different brands of cigarettes.

The hookah smokers mostly used Desi Punjab tobacco (leaves of a local variety of tobacco dried in air and sunlight) mixed with molasses (dense brownish sap formed during purification of cane sugar by boiling the extract from sugar cane) in 1:1 ratio by weight. The product was home made and without glycerine and any flavouring essences as is found in tobacco-molasses based mixtures smoked in shisha in other parts of the world particularly in Europe and the USA.¹⁴

The smoking device consisted of a Chilam (a funnel of volume approximately 500-700 ml) containing tobacco at its bed on a small stone covered by glowing charcoal. The individuals consumed about 2 "chattaks" of tobacco-molasses mixture (more than 120 grams) a day. The smoke was inhaled after passing through water and a long pipe. The individuals had been smoking hookah for durations varying from 2-15 years.

In case of non-smokers, the volunteers who never smoked in their life were included and occasional smokers were excluded. A total of 36 non-smokers served as controls. The age of these non-smokers ranged from 20 to 75 years. These controls were hospital staff and university students and belonged mostly to district Multan. Each smoker was interviewed to get the detail of his/her history of smoking. All the individuals were examined by a clinician to exclude the possibility of any disease, which causes elevated CEA levels.

Five cc of blood was taken from each smoker which was allowed to clot followed by centrifugation to get serum. Serum was then used in immunoassays to find the CEA level. The serum samples were stored at 4°C in a refrigerator for use in future.

Chemiluminescence immunometric technique was applied using immulite-2000 system to estimate CEA levels in sera of the subjects.

SPSS Version 10 was used for data entry and analysis. Student's t-test was applied to compare the levels of CEA to study different groups. Analysis of variance (ANOVA) was applied to compare results of different groups to find the statistical significance of our findings.

All the subjects voluntarily donated their blood samples. The smokers were informed well about the significance of the test before they donated blood samples and were assured of privacy of the test values.

Following values provided by the manufacturer were used as reference to draw conclusions in our study.

Normal values for male smokers (153 persons study):

2.1-6.2ng/ml.

Normal values for male non-smokers (226 persons study):

1.1-3.2ng/ml.

Normal values for female smokers (81 person study): 1.3-

4.9ng/ml.

Normal values for female non-smokers (262 persons

study): 0.8-2.5ng/ml.

Results

The CEA levels observed in different groups of smokers with different smoking rates are summarized in Table-1. The duration of smoking ranged from 8-15 years. The mean age of the smokers was 43.7 ± 16.4 years. There was a relationship between CEA level and number of cigarettes smoked per day. The mean levels of all smokers were above normal limits although the individual levels were sometimes within normal limits. A range of values between 0.85 to 13.9 ng/ml was observed in smokers of group-1(n=32; %High=56.25) who smoked 3-10 cigarettes per day. However, applying statistical test showed that these levels were significantly higher than the levels of non-smokers ($p=0.0002$). Similarly in group-2 (n=39; %High=66.7) and group 3 (n=17; %High=58.82) who smoked 11-30 cigarettes per day mean CEA levels varied widely and were significantly higher (p -values <0.0032 to 0.0001) than the levels of non-smokers. Significantly very high (p -value= 0.0001) mean levels were observed in group 4 (%High=65) and 5 (%High=65) smoking 31-60 cigarettes a day. The CEA levels observed in different brands of cigarettes are given in Table-2. People smoking cigarettes of 15 different brands were included in this study. The mean CEA levels observed in 3, 4 and 3 smokers of Wills King, Pine and Red and White respectively were less than 4 ng/ml and within control limits. The mean CEA levels in 6, 5, 16, and 3 smokers of Capstan, Benson and Hedges, Embassy and Time Square were below 5 ng/ml. In 33, 4, 3, 8, 4, and 10 smokers of Gold Leaf, Campus, Royal Filter, K-2 filter,

Table 1. CEA Levels (ng/ml) In Cigarette Smokers, Hookah Smokers And Non-Smokers.

Group	No of cigarettes/day	n	CEA levels (ng/ml)	p-values	
				*Smokers vs non-smokers	p-values Cigarette vs hookah
1	≤10/day	32	4.98+3.99	0.0002	0.32
2	11-20/day	39	5.42+6.1	0.0032	0.47
3	21-30/day	17	3.97+2.1	0.0001	0.23
4	31-40/day	20	20.4+25.3	0.0001	0.074
5	≥41/day	14	19.7+23.2	0.0001	0.076
All Cigarette Smokers	3-60	122	9.19+14.9	0.0067	
Hookah Smokers	---	14	7.161+10.38	0.0079	0.61
Non-Smokers		36	2.35+0.71	----	-----

*Hookah and cigarette smokers

Table 2. Brand of smoking (type of smoking) versus CEA levels (mean+SD).

Sr. No.	Brands of cigarettes	No of smokers	Average number of cigarettes smoked per day	CEA levels (ng/ml)
1	Capstan	6	27	4.20+2.52
2	Gold leaf	33	23	5.97+6.89
3	Wills king	3	13	1.23+1.53
4	Marvin gold	15	30	29.38+30.75
5	Benson and Hedges	5	18	4.28+3.70
6	Gold flake	10	23	7.89+5.40
7	Campus	4	16	6.1+2.57
8	Fedora	4	14	5.1+3.14
9	Derby	5	43	28.9+17.2
10	Pine	4	15	3.80+2.73
11	Embassy	16	18	4.16+2.54
12	K 2 Filter	8	33	5.5+7.25
13	Time square	3	25	4.4+3.17
14	Royal filter	3	10	6.5+2.40
15	Red & White	3	18	1.96+2.48

Fedora and Gold Flake respectively, the mean CEA levels were above 5 ng/ml but below 8 ng/ml. Significantly very high values ($p=0.0001$) were observed in 15 smokers of Morven Gold (29.38+30.75 ng/ml; %High=80) and 5 smokers of Derby (28.9+17.2; %High=100) ng/ml although levels were still within normal limits in some individuals. The values in these individuals were also significantly higher ($p=0.016$ and 0.0035 respectively) than mean values observed in hookah smokers. The mean CEA levels in rest of the brands were also significantly high ($p<0.001$) when compared with controls. Analysis of variance (ANOVA) showed a significant variation of CEA levels between different brands of cigarettes ($p<0.001$). However a significant proportion of the smokers were within normal limits. In hookah smokers the mean value of CEA observed was 7.16 ± 10.4 ng/ml (%High=42.8). The mean CEA level observed in non-smokers was 2.35 ± 0.71 ng/ml. The overall mean levels in cigarette smokers and hookah smokers did not differ significantly shown in Table-1. Significantly raised CEA levels ($p<0.0067$) were observed in 122 cigarette smokers when compared with non-smokers ($p=0.0067$). However comparison of these values with values of hookah smokers showed no significant difference ($p=0.61$). Levels were also high in 14 hookah smokers when compared with controls ($p=0.0079$).

Discussion

Smoking is inhalation and exhalation of the fumes of burning tobacco in cigars, cigarettes, pipes and hookah. In contrast with cigarettes, hookah (also called narghile or

shisha) smoking involves important differences in temperatures (several hundreds of degrees). In many cases the tobacco-molasses mixture is not burnt but rather heated by a piece of charcoal according to a chemical reaction of the Maillard type.¹⁴

Sajid et al have shown that hookah smoke may contain, depending on the size of the apparatus and the nature of charcoal and tobacco, very high content of CO, which could induce heart diseases in hookah smokers.¹⁷ Work on shisha smoking in Saudi Arabia, very similar to Pakistani hookah use, suggests that some carcinogens may be filtered by the device.¹⁸ Rakower and Fatal¹⁹ early hypothesized the influence of the lower temperatures on the formation of the carcinogenic PAH (Polynuclear Aromatic Hydrocarbons). A comprehensive review of the world literature showed a weak relation between lung cancer and hookah smoking.²⁰ Lung cancer is mainly due to the action of the PAHs and the TSNA (Tobacco-Specific Nitrosamines) and, to a lesser degree, to polonium 210 and volatile aldehydes.^{21,22} Aldehydes (acetaldehyde, formaldehyde, acrolein) are filtered in great proportions and the two first elements are known contributors to lung cancer.^{21,23}

Carcinoembryonic antigen (CEA) is elevated in malignant tumours. It has also been found elevated in some nonmalignant tumours such as pleural effusions.²⁴ One of the most useful applications of this marker is as a post surgical prognostic indicator in the treatment of neoplasms. Greater-than-normal value of CEA might indicate the presence of cancer of the large intestine (colon and rectum).

However, heavy smoking can raise CEA levels.¹⁰ Work of Fukuda et. al showed that CEA-positive subjects were heavy smokers.¹¹

In the current study smokers using more than 30 cigarettes a day, had highest mean levels of CEA and the percentage of persons with elevated CEA levels in these groups were 65%-71.4%. These smokers were therefore at high risk of cancer compared to the smokers smoking less than 30 cigarettes a day.

Highest mean levels were observed in two brands of cigarettes i.e. Morven Gold and Derby, which reached the CEA levels up to about 30 ng/ml. The rate of smoking (number of cigarettes smoked per day is also high in these smokers (i.e., 30 and 45 cigarettes of cigarettes per day. These are low price and probably poor quality brands and are being used by low-income groups (the volunteers using these brands belonged to low socioeconomic classes).

The observed CEA levels in hookah smokers were 7.1 ± 10.48 ng/ml. The percentage of individuals with high CEA levels in hookah smokers was 43%. This result

indicated that a significant proportion of hookah smokers have very high levels of CEA. On one hand, this might be due the fact that water filtration does not remove all the carcinogenic and toxic chemicals. It is also possible that the selected volunteers were also cigarette smokers, ex-cigarette smokers with a smoking career varying in duration, or even recent cigarette (or bidi) smokers having switched to hookah smoking, naively believing that this mode of tobacco use would be less detrimental to their health.

Conclusion

In the light of findings, it was concluded that the brands of cigarettes and the rate of smoking both play an important role in raising the CEA levels and the belief that hookah is a safer device for smoking undoubtedly requires further investigations involving a higher number of hookah smokers.

Acknowledgement

The authors acknowledge with thanks the financial support provided by Bahauddin Zakariya University, Multan for this work.

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