

Hematological and Inflammatory Parameters in Hookah Smokers and Nonsmokers: A Cross-sectional Study

Sidra Latif¹, Muniza Saeed²

Abstract

Objective: To observe the effects of hookah smoking on hematological and inflammatory parameters in chronic hookah smokers.

Methods: A cross sectional observational study was conducted in the setting of Post Graduate Medical Institute, Lahore from March to September, 2021, on 30 male chronic hookah smokers, who had been smoking hookah for more than 5 years, in the age range of 30-60 years and a comparison of their hematological parameters was done with 30 subjects of the same age group and ethnic background with no history of hookah smoking. Fresh blood samples from antecubital vein were collected and tested for hemoglobin (Hb) content, red blood cells (RBC) count, packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC), platelet count, neutrophil count, lymphocyte count and neutrophil lymphocyte ratio (NLR). An automatic hematological analyzer was used to get results. High sensitivity CRP (hs-CRP) was measured using Elisa kit. Data was analyzed using SPSS 21.

Results: A statistically significant difference was found in Hb, PCV, MCV, MCH, MCHC, platelets, MPV ($p < 0.05$). Inflammatory markers such as hs-CRP ($p = 0.05$), NLR ($p = 0.03$) were significantly higher in hookah smokers as compared to non-smoker.

Conclusion: Hookah smokers have altered hematological and inflammatory parameters and are at higher risk of developing atherosclerosis, cardiovascular and pulmonary diseases associated with these alterations.

Keywords: Hookah smokers, hematological parameters, inflammatory parameters.

Introduction

Tobacco smoking is associated with the development of many pathological conditions. It is contemplated as a prime risk factor for the cardiovascular diseases, chronic obstructive pulmonary diseases, autoimmune diseases, metabolic syndrome, and cancers.¹ According to world health organization (WHO) tobacco kills more than 5 million people each year.² A large variety of tobacco products are used worldwide. These include cigarettes, cigars, electronic cigarettes and one form of tobacco use is hookah, also called waterpipe, shisha or narghile. More than 100 million of the world population are hookah smokers.³ Hookah is a classic form of tobacco smoking which is still very popular in rural areas of Pakistan. Prevalence of hookah smoking in Pakistan among adults is 13% and among university students it is 33%.⁴ Traditional hookah in Pakistan consists of a

bowl (chillum), a hose with a mouthpiece, and a water base. Dry tobacco is placed in the bowl and heated by using burning charcoal. Smoke is produced by burning of tobacco and charcoal. It contains many toxicants like cigarette smoke, carbon monoxide, nitrosamines, polycyclic aromatic hydrocarbons, heavy metals, benzene, nitric oxide and volatile aldehydes. These toxicants exert short term and long health effects.⁵

Tobacco smoking promotes atherosclerosis which is the major cause of death as a result of coronary artery disease, cerebrovascular and peripheral arterial disease. Endothelial dysfunction increases oxidative stress, enhances thrombosis, and chronic inflammatory mechanisms link the tobacco smoking with cardiovascular diseases.⁶ Oxidative stress also has a role in the pathogenetic process of chronic obstructive pulmonary disease.

Tobacco smoke causes systemic and local activation of the immune system. White blood cells interact in the formation of atherosclerotic plaques. Increased levels of monocytes, neutrophils, and lymphocytes are found in tobacco smokers when compared with non-smokers.⁷ Hookah is usually considered as the harmless alternative of cigarette smoking and so abundantly in use even by university students⁸ in urban areas of Pakistan now a days. There is a false belief that the hookah smoke is purified by passing through the water base of hookah. Infact, hookah smoke is even more damaging to health due to the presence of more harmful compounds found in cigarette smoke.⁵ Very few studies are available on detrimental effects of hookah smoking, and therefore, the purpose of this study was to measure the hematological and inflammatory biomarkers in hookah smokers and to compare them with healthy non-smokers to evaluate the effect of hookah smoking and make the public aware about the health hazards of hookah smoking.

Methods

A cross sectional observational study was conducted in the setting of Lahore General Hospital affiliated with Post Graduate Medical Institute (PGMI), Lahore from March to September, 2021, on 30 male chronic hookah smokers, who were smoking hookah for more than 5 years, in the age range of 30-60 years and a comparison of their hematological parameters was done with 30 subjects of the same age group from same locality and ethnic background with no history of hookah smoking. For this study, subjects recruited were traditional hookah smokers from the rural areas of Punjab, Pakistan who were visiting Lahore General Hospital for treatment. Smokers were using classical form of hookah containing tobacco, one head per day for the last five years.

Study plan was approved by the Ethical Review Committee and informed consent was taken

¹ Department of Physiology, Faisalabad Medical University, Faisalabad, Pakistan

² Department of Physiology, Post Graduate Medical Institute, Lahore, Pakistan

Correspondence to

Dr. Sidra Latif

Department of Physiology, Faisalabad Medical University, Faisalabad, Pakistan

E-mail: sidra_lateef@yahoo.com

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from all the participants; those who were not having history of alcohol intake, cancer, cardiovascular diseases, cerebrovascular events, cigarette smoking, asthma, diabetes mellitus, hepatic diseases, any medication and nutritional supplements, obesity, and systemic infections. Subjects were inquired about sociodemographic factors such as age, education, lifestyle, and occupation. Weight and height were measured by using standard scales. Body Mass Index (BMI) of each participant was determined by using the Body Mass Index Calculator⁸ and 4 ml of venous blood was taken from antecubital vein from each subject. Complete blood count (CBC) was run on this sample using Sysmex automated hematology analyzer and results obtained. ELISA kit, Bio Check, Inc, Foster city was used to measure hs-CRP (C-Reactive Protein High-Sensitivity) levels.

Computer software IBM SPSS version 21 was used for data analysis. Variables were tested for normality using Kolmogorov test and homogeneity of variance using Levene's test. Data with P value less than 0.05 was considered as non-normally distributed data. Data was expressed in Mean ± SD if normally distributed. Non-normal quantitative variables were presented as median IQR. Student t test (parametric test) compared the variables of two groups for the data having homogeneity of variances and normal distribution. Mann Whitney U test (non-parametric test) was applied to compare differences between the two groups for non-normally distributed quantitative data. p ≤ 0.05 was considered significant.

Results

The mean age of the group I and II was 40.30±6.44 years and 39.74±6.29 years respectively. Groups were having no significant difference in age, weight, height, and BMI as shown in table 1. Hb (p=0.00), MCH (p=0.00), and MCHC (p=0.00) were significantly higher. MCV (p=0.02), PCV (p=0.01) and MPV (p=0.00) were significantly lower in hookah smokers as shown in table 2.

Serum levels of neutrophils (p<0.001), NLR(p=0.03) and hs-CRP (p=0.05) were significantly higher in hookah as compared to non-smokers as shown in table 3. Majority of (75%) hookah smokers had hs-CRP level <1 mg/l and 25% had hs-CRP level between 1-3 mg/l as shown in table 4.

Table 1: Baseline data of study participants

Anthropometric variables	Group I (Nonsmoker:30)		Group II (Hookah smoker:30)		Sig.
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
ΔAge (year)	40.30±6.44	40.50 (11.00)	39.74±6.29	40.00 (8.75)	0.73
ΔWeight (kg)	76.47±10.05	76.50 (18.25)	74.17±12.35	71.50 (19.50)	0.43
ΔHeight (m)	1.69±0.09	1.67 (0.13)	1.69±0.07	1.69 (0.09)	0.74
□BMI (kg/m ²)	26.32(5.36)	26.33 (3.73)	25.35 (5.58)	25.36 (5.58)	0.12

Δ: values in Mean ± SD (n=30); □ : value in median IQR, BMI: body mass index

Table 2: Hematological parameters in hookah smoker and

variables	Group I (Nonsmoker:30)		Group II (Hookah smoker:30)		Sig.
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
ΔHbg/dl	13.91±1.39	14 (1.55)	15.38±1.45	15.40 (1.82)	0.00
□RBCCount (10 ¹² /L)	5.22±0.39	5.27 (0.50)	5.20±0.52	5.17 (0.42)	0.43
ΔMCV(fl)	88.33±7.63	88.80 (10.70)	84.45±4.87	84.80 (5.67)	0.02
□PCV (%)	46.15±5.29	46.50 (5.71)	42.91±6.26	44.25 (5.35)	0.01
ΔMCH(pg)	26.68±2.09	26.66 (2.05)	29.75±2.73	29.66 (3.28)	0.00
ΔMCHC(g/dL)	30.28±2.48	30.20 (4.28)	34.98±2.22	34.90 (2.88)	0.00
ΔPlatelet Count(10 ⁹ /L)	236.77±56.72	236.50 (75.25)	223.23±44.14	219.00 (54.75)	0.31
□MPV (fl)	11.09±1.63	10.70 (2.25)	8.96±1.99	8.50 (3.15)	0.00

Δ Compared by Independent sample “t” test., □ Compared by Mann Whitney U test, MPV = mean platelet volume, Hb = hemoglobin, MCV = mean corpuscular volume, PCV = packed cell volume, TRBC = total red blood cell count, MCH = mean corpuscular hemoglobin, MCHC = mean corpuscular hemoglobin concentration

Table. 3 Biomarkers of systemic inflammation

variables	Group I (Nonsmoker:30)		Group II (Hookah smoker:30)		Sig.
	Mean ± SD	Median (IQR)	Mean ± SD	Median (IQR)	
ΔNeutrophils (%)	51.42±10.92	52.00 (12.10)	60.45±7.89	59.60 (13.05)	<.001
ΔLymphocytes (%)	36.60±7.62	36.05 (9.00)	33.73±7.20	34.85 (11.50)	0.14
□NLR	1.53±0.71	1.44 (0.69)	1.89±0.83	1.69 (1.06)	0.03
□WBC (10 ⁹ /L)	7.05±1.55	6.98 (2.10)	6.95±1.98	6.47 (1.69)	0.46
□PLR	6.80±2.02	7.13 (2.95)	6.95±2.30	6.35 (2.61)	0.90
□hs-CRP (mg/L)	0.17±0.18	0.10 (0.10)	0.44±0.64	0.20 (0.20)	0.05

Δ Compared by Independent sample “t” test., □ Compared by Mann Whitney U test, NLR = neutrophil lymphocyte ratio, □WBC = white blood cell, PLR = platelet lymphocyte ratio, hs- CRP = high sensitivity c reactive protein

Table. 4 Frequency distribution in relation to hs-CRP

hs-CRP (mg/L)	Group I(Non-smokers:30)	Group II(Hookah smokers:30)
	Frequency (%)	Frequency (%)
< 1	30(100%)	25(75%)
1-3	0(0%)	5(25%)

*hs- CRP = high sensitivity – C Reactive Protein.

Discussion

Our findings showed that hookah smokers were having higher Hb in contrast to non-smokers while having equal values of red blood cells (RBC). This study showed significantly increased values of MCH and MCHC in hookah smokers compared to non-smokers. Hookah smokers showed significantly decreased levels of PCV when compared with non-smokers. Our results are consistent with the findings of Malenica et al. (2017).⁹ They conducted a study to observe the hematological parameters in male and female smokers and compared them with the controls. Increase in Hb concentration might be due to the formation of carboxyhemoglobin causing decrease oxygen supply to the tissues. It shifts the Hb dissociation curve to the left side. To recompense this decreased oxygen supply higher Hb levels are maintained by the smokers. Increased capillary permeability which is caused by CO decreases the volume of plasma.¹⁰ Our findings are also consistent with this study as it found a similar increase in Hb concentrations of hookah smokers as compared to cigarette smokers and standards.

Nadia et al. (2015)¹¹ conducted a study to explore the outcomes of hookah and cigarette on hematological parameters in male population of Sudan. Hookah smokers were found to have higher levels of Hb, PCV, MCV, MCH, MCHC, platelets and neutrophils. Whereas RBC count, PCV and MCV was found lower in hookah smokers than non-smokers. Our study found similar results of Hb, MCH, MCHC. In our study neutrophils and NLR were found significantly increased in hookah smokers and lymphocytes showed no significant difference between two groups. Leukocyte count is considered a prognosticator of atherosclerosis and cardiovascular diseases. In

the respiratory system tobacco smoke cause inflammation and release of inflammatory cytokines. This effect the number of leukocytes. Nicotine induced release of catecholamines are also responsible for increased leukocyte counts. Increased leukocyte aggregation predisposes microvascular occlusion and take part in the pathogenesis of cardiovascular diseases.⁶

The hookah smoking has significant association with systemic inflammation.¹² In their study NLR is found significantly higher in hookah smokers than non-smokers. These results are consistent with our study. A statistically significant difference in median IQR of MPV of hookah smokers and non-smokers is seen. Difference was not statistically significant for platelets counts. Platelets and MPV were decreased in hookah smokers as compared to non-smokers. Our findings are consistent with the Miri-Moghaddam et al. (2014).¹³ They conducted a study on young male Wistar rats which were exposed to hookah smoke in a specially designed apparatus. Blood samples were obtained after sacrificing them through ether inhalation method. They found decrease in platelet count, but the change was insignificant. Whereas some studies showed elevation of platelet count in smokers. A study was conducted on Copenhagen General Population to find out the effects of tobacco smoking on WBC, RBC, and platelets. Free radicals in tobacco smoke induce a systemic inflammatory response by release of proinflammatory cytokines. This condition promotes the differentiation of megakaryocytes in bone marrow.¹⁴

High sensitivity CRP was significantly higher (p = 0.05) in hookah smokers than non-smokers. Five hookah smokers in our study had hs-CRP levels between 1-3 mg L-1 and these levels are considered as moderate risk of CVD. Our findings are consistent with the findings of Ahmed et al. (2020).¹⁵ Their study was aimed to know the effects of different types of tobacco smoking on hs-CRP in healthy adults and it discovered significantly increased hs-CRP levels in hookah smokers. It compared hs-CRP levels in 30 hookah smokers, 30 cigarette smokers and 17 non-smokers. In contrast to our study levels were found non significantly higher in hookah smokers. This may be due to multiple factors like inclusion of passive smokers in non-smokers’ groups, alter-

ing actions of plasma hs-CRP levels, and potential genetic polymorphism.¹⁶ There is inflammatory and proatherogenic effect of hs-CRP. It binds with LDL at atherosclerotic lesion site and also inhibits the NO production by endothelial cells.¹⁷

Conclusion

Our study concluded that hookah smoking is injurious to health because it alters the hematological and inflammatory parameters and hookah smokers are at higher risk of developing atherosclerosis, cardiovascular and pulmonary diseases associated with these alterations.

Limitations of this study

This study should also have been conducted on the university students of urban population living in Lahore to check the impact of hookah smoking on their hematological parameters but due to time constraint and limitation of funds, we could not include them in our sample.

Authors' Contribution

SL did data collection and manuscript writing. MS reviewed the literature, helped with manuscript writing and interpreted the results.

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Conflict of interest: None

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