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Original Research Article

Impact of Tobacco Cigarette Smoking on Hematologic parameters among male Subjects in Port Sudan Ahlia College, Sudan

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Abstract: The disorder of tobacco cigarette smoking is common worldwide. However, alterations in hematological parameters were expected. Data from Sudanese on this field is limited. The study aimed at identifying the impact of tobacco cigarette smoking on hematologic characteristics of blood. A cross-sectional descriptive study was conducted in Port Sudan Ahlia College, Sudan. Two hundred male subjects participated in this study: smokers (n=100) and non-smokers (n=100). Complete blood count was performed by using URIT automated hematology analyzer. The smoker subjects had significant high levels of red blood cells ($P < 0.001$), hematocrit ($P < 0.000$), hemoglobin ($P < 0.000$), and mean corpuscular volume ($P < 0.004$), whereas mean corpuscular hemoglobin concentration ($P < 0.000$) was significantly low. Accordingly, our results indicate that the prolonged smoking has adverse effects on hematologic parameters and these changes may predicted with a high risk for developing hypercoagulability, polycythaemia or other serious diseases.
Keywords: Tobacco, Cigarette smoking, CBC, Port Sudan Ahlia College, Sudan

INTRODUCTION

Tobacco cigarette smoking is one of the major leading causes of death and essential public health challenge in world over [1]. It is the prime cause of death worldwide, resulting in millions of deaths annually, more than HIV/AIDS, tuberculosis and malaria [2]. Smoking has effect on hematological parameters. There are more than 4000 chemicals found in cigarette smoke, and the smoker is exposed to a number of harmful substances including nicotine, free radicals, carbon monoxide and other gaseous products [3]. It is widely known that smokers have higher risk for cardiovascular diseases, hypertension, inflammation, stroke, clotting disorder, and respiratory disease [4]. Moreover, cigarette smoking accelerates pathogenesis in different type of cancers such as lung, pancreas, breast, liver and kidney [5]. Similarly, it also changes the pH in stomach that resulted in peptic ulcers and gastric diseases [1]. In Sudan, prevalence of cigarette smoking in the population reached 12% [6]. Alternatively in the some developed countries, although prevalence of cigarette smoking is almost double that of Sudan, it started to decrease over the last year [7]. The benefits of smoking cessation have been well demonstrated. It reduces health risks and improves quality of life. The cumulative risk of dying from cardiovascular and other lung diseases can be significantly reduced (by up to 90%) if smokers quit smoking, even late in life. Therefore, every smoker should be actively encouraged to stop smoking. Due to tobacco's highly addictive properties, cessation attempts need to be supported by health care professionals to achieve long-term abstinence. Physicians are in an ideal position to advise and educate patients about the dangers of smoking. Moreover, they act as visible role models and may unintentionally affect the smoking behavior of others [8]. Relatively few subjects (15-38%) found it necessary to advise smokers to quit before they had developed a smoking related disease [9]. Cigarette smoking is also prevalent among students of health care professions. One study showed that 29% were current smokers among students of the College of Applied Medical Sciences in Riyadh; KSA. Four another studies showed that regular smoking has a prevalence rate of 13.6% among medical students at the University College of Medicine in Abha, KSA [10]. In Sudan, there is one published data about smoking among students, the smoker's rate were 8% [11]. In last decade, it was suggested that cigarette smoking affect the blood characteristics as well that

leads to death. For example, relation between smoking and white blood cell count has been well established [12]. Most of studies, it has been found that smokers have higher white blood cell counts than nonsmokers [13]. Some scientists suggested that increase in hemoglobin level in blood of smokers could be a compensatory mechanism. However, some were of view that smoking does not increase in hemoglobin level in all smokers and this relates to tolerance potential of individual to different kind of diseases. Moreover, episodic duration of smoking and age of individual might have changed the adverse effects of smoking on blood characteristics of human being [14]. Simple investigations like hematological count may gives clues about the possible complication of smoking in the future. In Sudan, previous studies evaluating these simple parameters are scarce, if present. Unfortunately, due to short facilities, inflammatory marker such as fibrinogen level was not assessed in this study. The present study was undertaken to find out the extent of adverse effect of tobacco cigarette smoking on hematologic characteristic of blood in male subjects of Port Sudan Ahlia College, Sudan.

MATERIAL AND METHOD

Subjects

This is a cross-sectional study designed to identify the impact of tobacco cigarette smoking on hematologic characteristics of blood. This study was conducted in March 2016 in Port Sudan Ahlia College, Sudan. The study involved two groups: a control group of apparently healthy non-smokers (N = 100) matched for age with a test group of smokers (N = 100). The age range of both groups was 17 - 66 years. The inclusion criteria were the subjects ≥ 16 years and ≤ 66 years. Smokers who are smoking cigarettes for a minimum period 4 – 6 months, no history of drug usage and none had donated or received blood in last 6 months. Individuals who will affirm that they have not smoked yet (or very rarely tried to smoke) will be considered as non smoker. The exclusion criteria include subject who are on drugs (e.g. inhaled steroid) which may affect hemoglobin level and subject with severe illness (uncontrolled diabetes or hypertensive).

Smokers Category

Smokers were further categorized on the basis of their daily number of cigarette smoked as; light smokers who smoked ≤ 10 cigarette daily, moderate smokers who smoked 11 – 20 cigarette daily and heavy smokers who smoked ≥ 20 cigarette daily. Those subjects who had quit smoking at the time of study were defined as ex-smokers and were further categorized on the basis of the time since their smoking cessation before the study.

Examination and Laboratory tests

A brief history of each subject was taken, along with measurement of height, weight and blood pressure. Blood pressure (BP) of every subject was determined with electronic sphygmomanometer (Bokang, BK6023, China) as mmHg. The body weigh was measured using electronic scale balance (Target, model NO. 8844, Taiwan). The body weight (kg) of each subject was divided by the square of his height (m) to calculate his body mass index (BMI).

Blood samples were collected from the entire study members. About 3 ml of blood was transferred to tri potassium ethylene diamine tetra acetic acid (K_3EDTA) tube. Complete blood count was done which include White Blood cells (WBC) counts, Red Blood cells (RBC) count, Hemoglobin (Hb), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), Platelets (PLT) count, Plateletcrit (PCT), Mean Platelet Volume (MPV), Platelet Distribution Width (PDW) and Platelet large cell ratio (P-LCR) using semi automated hematology analyzer (URIT 3010, E 02211 PR China). The specimens were analysed within 1 hour from vene section to avoid the problems occurring when EDTA collected samples are analysed.

STATISTICAL ANALYSIS

Data analysis was performed using The Statistical Package for Social Sciences (SPSS version 20.0, IBN. Chicago, USA). The hematological parameters of smokers and non-smoker were statistically tested by compare mean and Chi-square test which ever was appropriate. A P.value less than 0.05 were considered statistically significant.

Ethical consent

Written informed consent was obtained from each respondent. The Ethical Committee of the Department of Hematology, Medical Laboratory Sciences, and Port Sudan Ahlia College approved the study.

RESULTS

A prospective cross-sectional study was conducted in March 2016 at Port Sudan Ahlia College, Port Sudan, Sudan. Table 1 shows the selected baseline characteristics of subject's smokers. The mean age of smokers and non-smoker were 24.6 ± 9.2 and 22.2 ± 5.5 years respectively. Blood pressure was observed in smoker subjects having mean systolic BP 141±19.5 and mean diastolic BP 85.5±9.0 whereas observed in non-smoker subjects having mean systolic BP 136.2±17.8 and mean diastolic BP 84.0±8.4. In addition to, a high body mass index was noted high in smokers group (mean ± SD 23.19 ± 5.0) in compared with non-smoker group (mean ± SD 22.81 ± 4.7). The status of smoking

according to the group was depicted in Table 2. Smoking was more common in below 25 years. On average, subjects smoked 28.6 cigarettes daily and had a mean smoking history of 7 years (Table 1).

Table 3 indicates the changes in hematological parameters of smokers and non-smokers; RBC, Hb, HCT, MCV, MCH, and PLT were significantly high. MCHC, MPV, PCT, and P-LCR were significantly lower in smokers as compared to non-smokers. PDW did not show any significant difference. Smokers had significant high level of erythrocyte count than non-smokers group (4.95 $x10^3$/µl vs. 4.67 $x10^3$/µl) ($P < 0.001$). Erythrocyte count was found to be positively significant with the duration of smoking ($P < 0.027$). Similarly, smoker subjects had high mean HCT 47% than non-smokers 40.5% which was found to be significant ($P < 0.000$). HCT also was positively related with increased in the duration of smoking ($P < 0.001$). Moreover, Smokers were observed had high hemoglobin levels when compared with non-smokers (15.2 g/dl vs. 13.7 g/dl) ($P < 0.000$). A positive association was also observed between hemoglobin levels and the duration of smoking ($P < 0.017$). However, means MCV 90.9 Fl and MCHC 31.9 g/dl were significant with smokers than in non-smokers ($P < 0.004$ and 0.000 respectively). MCV and MCHC were also having association with duration of smoking ($P < 0.032$ and 0.000 respectively). On the other hand, mean of MPV 11.2 Fl, mean of PCT 0.29 %, and mean of P-LCR 17.7 % were lower in smoker's subject than non-smokers 11.3 Fl, 0.30 %, and 18.3 % respectively.

Table 1: Baseline characteristics of the study subjects

Variables	Mean± SD	Range
Age (year)	24.6±9.2	18 – 66
Body weight (Kg)	70.59±15.8	40 – 120
Height (Cm)	174.26±7.3	152 – 196
Body mass Index (kg/Cm^2)	23.19±5.0	14.6 – 40
Systolic blood pressure (mmHg)	141.1±19.5	106 – 197
Diastolic blood pressure (mmHg)	85.5±9.0	60 – 109
Cigarette/day (Cigar)	28.6±31.5	2 – 182
Duration of smoking (year)	7.0±7.6	1 – 46

Kg = kilogram; Cm = centimeter; mmHg = millimeter of mercury

Table 2: Smoking status of subjects according to age group

Age	Non-smoker n=100	Ex-smoker n=7	Li-smoker n=26	Mo-smoker n=29	He-smokers n=38	Total
16 – 20	49 (58.3%)	7 (8.3%)	9 (10.7%)	10 (12%)	9 (10.7%)	84 (42%)
21 – 25	39 (46.9%)	0	13 (15.7%)	16 (19.3%)	15 (18%)	83 (41.5%)
26 – 66	12 (36.4%)	0	4 (12.1%)	3 (9.1%)	14 (42.4%)	33 (16.5%)
Total	100 (50%)	7 (3.5%)	26 (13%)	29 (14.5%)	38 (19%)	200 (100%)

Li= light; Mo = moderate; He = heavy

Table 3 Summary of hematological parameters in smokers as compared with non-smokers

Parameters	Smokers (n=100) Mean ± SD	Non-smokers (n=100) Mean ± SD	P. value
WBC $x10^3$/µl	4.871±1..662	5.223±1.763	0.148
RBC $x10^3$/µl	4.95±0.55	4.67±0.57	0.001*
Hemoglobin (gm/dl)	15.22±1.2	13.76±1.1	0.000*
HCT (%)	47.0±3.8	40.5±5.1	0.000*
MCV (Fl)	90.9±9.6	87.2±8.4	0.004*
MCH (Pg)	30.3±3.0	29.8±4.5	0.308
MCHC (g/dl)	31.9±2.0	34.2±3.6	0.000*
PLT $x10^3$/µl	279.0±133	275.0±67	0.800
MPV (Fl)	11.2±.95	11.3±1.1	0.410
PDW (Fl)	14.5±2.0	14.5±2.4	0.923
PCT (%)	0.29±0.05	0.30±0.06	0.281
P-LCR (%)	17.7±4.7	18.3±5.5	0.503

* Statistically significant

White Blood cells (WBC), Red Blood cells (RBC), Hemoglobin (Hb), Hematocrit (HCT), Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC), Platelets (PLT), Plateletcrit (PCT), Mean Platelet Volume (MPV), and Platelet Distribution Width (PDW).

DISCUSSION

Tobacco cigarette smoking has been correlated to cause many major problems in subjects. It is important to do such as this study to provide data and to highlight the impact to tobacco on hematological parameters. Therefore, the aim of this study to assessed the extent of adverse effect of smoking on hematological characteristics of blood among Port Sudan Ahlia College subjects. However, there is only study on cigarette smoking had been performed among university students in Sudan. This study carried out at 2013 [11], and reported that among medical students the prevalence of cigarette smoking was 10%. The results of present study reveal a consistent and statistically significant association of cigarette smoking with most of the hematologic parameters, especially a positive association with the duration of smoking. These findings confirm previous reports [13, 15].

Our results showed significant differences in hematological parameters of subjects; RBC, Hb, MCV, PLT, MCH and HCT were significantly high whereas MCHC, MPV, P-LCR and PCT were significantly low in smokers as compared to non-smokers. We did not find any significant difference in PDW level. WBC count is may be the most useful, inexpensive and simple indicator for endothelial damage. We found that regular smokers had insignificantly lower WBC count compared to non-smokers ($P < 0.148$). The low WBC count in male smokers in this study is in contrast with other published reports [13.14]. The mechanism for smoking-induced increase in WBC level is not clear. It has been suggested that inflammatory stimulation of the bronchial tract induces an increase in inflammatory markers in the blood but it has also been suggested that nicotine may induce an increase in blood lymphocyte counts [16]. The hemoglobin value was significantly high in smokers ($P < 0.000$). Elevated levels of hemoglobin are correlated with increased numbers or sizes of erythrocytes. RBC value was significantly high in smokers than those of non-smokers ($P < 0.001$) and is consistent with other investigations [1, 17]. It is reported that high level RBC and Hematocrit are associated with blood viscosity and clotting in smokers [18-19]. High level of RBC is termed as pseudo polycythemia and very high RBC mass slows blood velocity and increase the risk of intravascular clotting, coronary vascular resistance, decreased coronary blood flow, and a predisposition to cause thrombosis [20]. It has been established that fibrinogen levels are higher in smokers than in non-smokers, and it has been estimated that the increasing risk of cardiac disease in smokers may be associated with high fibrinogen levels through arterial wall infiltration and effects on blood viscosity, platelet aggregation, and fibrin formation [13, 21]. This elevation may lead to pulmonary fibrosis and elevated erythropoietin [1, 17, 22]. Smoking cigarettes creates a unique condition of combined polycythemia to chronic hypoxia, leading to increased red blood cell production due to elevated carboxy hemoglobin (COHb) level, with concomitant reduction in plasma volume. Overall, thrombosis is a serious complication of polycythemia which can lead to death in up to 8.3% of patients [20]. Hematocrit value was also significantly high in smokers than those of non-smokers ($P < 0.000$); this result is consistent with previous findings [1, 17]. Higher levels of hematocrit may cause polycythemia Vera (PV), a myeloproliferative disorder in which the RBCs are produced excessively by bone marrow, and increased risk of development of atherosclerosis and cardiovascular disease [23]. In cigarette smoking, carbon monoxide (CO) is produced by the incomplete combustion of carbon-containing material. CO has a very high affinity for hemoglobin relative to that for oxygen (approximately 200-fold). Thus, CO displaces oxygen from hemoglobin in red cells to produce carboxy hemoglobin, which reduces the release of oxygen to tissues. Higher levels of hematocrit and hemoglobin have been demonstrated in smokers, and these increases are likely to be compensatory for exposure to CO]. Increased hematocrit and hemoglobin concentrations observed in smokers that may contribute to a hypercoagulable state [24]. In our result, we did not find any significant changes in MCH and platelets indices (PLT, MPV, PDW, PCT, and P-LCR) between smokers and non-smokers. Butkiewicz *et al.;* and Arslan *et al.;* studied the effect of smoking on platelet activation and some morphological parameters including MPV and they did not find any effect of smoking on MPV between the smoking and non-smoking healthy male participant [25, 26], a finding which consistent with our result. In this study, we found increase in MCV ($P < 0.004$) and decrease in MCHC levels. The significantly low value of MCHC ($P < 0.000$) among smokers indicating hypochromia and might be due to paucity of folic acid or vitamin B12 or thyroid problems. [27].

A limitation of this study is its cross-sectional design. Longitudinal studies in the future may give much proper insight on the outcomes. Other limitations of this study that not using any assay as a source of inflammatory marker.

CONCLUSION

The findings clearly indicate that the prolongation of smoking has adverse affects on hematologic parameters. These alterations in the blood accompanied by high blood pressure and increased body mass index and may predicted with a high risk for developing hypercoagulability, polycythaemia or other serious diseases.

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