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Effect of Cigarette Smoking on Erythrocytes, Leukocytes and Haemoglobin

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The association of erythrocytes and leukocytes count and haemoglobin level with cigarette smoking was studied and results were compared with non-smokers. The erythrocytes count in smokers was significantly high ($p < 0.0005$) compared with the non-smokers. The leukocytes count was significantly higher ($p < 0.02$) in non-smokers compared with the smokers. The difference in haemoglobin level was also significant ($p > 0.05$) between smokers and non-smokers, smokers being having low level of Hb. The number of cigarettes smoked per day and length of smoking showed the negative correlation with erythrocytes count and positive correlation with leukocytes. The haemoglobin also showed the negative correlation with the number of cigarettes per day ($r = -0.57$) and period of smoking ($r = -0.46$).

Key words: Cigarette smoking, leukocytes, erythrocytes, haemoglobin

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Introduction

It is well known fact that smoking does affect the health. It increases the heart rate, blood pressure, cardiac output, stroke volume, velocity of contraction, myocardial contraction force and myocardial oxygen consumption; development of arrhythmia and alteration of electrocardiographic and ballistocardiographic patterns (Clark ***et al.***, 1967 and Chalmers ***et al.***, 1997). It also induces the synthesis of heat shock/stress proteins (Vayssier ***et al.***, 1998). Smoking depresses the ability of macrophages to release cytokines that may lead various ailments. Nicotine increases circulation of free fatty acids and causes the increase of stickiness and aggregation of platelets (Wanzel ***et al.***, 1959; Ponzer ***et al.***, 1970). Smoking produce carbon monoxide that bind more firmly with haemoglobin compared with oxygen and lead to the disturbance of the normal function of the protein (Oski ***et al.***, 1970). Cigarette smoking is found to be associated with the major depressive disorder and leukocyte counts for men (Surtees ***et al.***, 2003).

It has been postulated that the use of tobacco in any form may lead of lips, tongue, tonsils, larynx, lung, stomach, intestine, pancreas and bladder cancer (Levin ***et al.***, 1950).

The incidences of lung cancer are significantly higher in smokers (Pike ***et al.***, 1975) and female smokers are more prone compared with the male smokers (Tang, 1989). The majority of patients that suffers from chronic obstructive pulmonary disease are cigarette smokers (Coondy ***et al.***, 1975). It has been found that cigarette smoke inhibit ciliary activity of the bronchial epithelium (Dalhamn and Rylander, 1970). The low level of plasma vitamin C and beta-carotene (Lee ***et al.***, 1998) and significantly low levels of selenium and zinc (Khurshaid ***et al.***, 1995) in smokers may be the result of alter absorption of certain nutrition component of the food. Nicotine suppresses the immune system (Genz ***et al.***, 1995). The low concentration of testosterone was observed in male smokers (Shaarawy and Mahmoud, 1982) that may decrease the stimulation of the seminal vesicles and results in lower ejaculate volume (Marshburn, 1989). Smoking causes the infertility; therefore, the physicians should advise infertile men who smoke cigarettes to quit (Saleh ***et al.***, 2002). Carbon monoxide binds more readily to haemoglobin than oxygen and as such smoking desaturates the blood. It is suggested that smoking during pregnancy stimulates fetal erythropoeisis (D'Souza, 1978)

The purpose of this study was to evaluate the effect of smoking on various haematological parameters.

Materials and Methods

Selection of patients and analysis of blood samples

Male individuals (127) between the age group of 23-35 years were randomly selected and divided into smokers (n = 100) and non-smokers (n = 27). The volunteers suffering from any disease or using any medicines were excluded from the study. After obtaining the informed consent the physical parameters like blood pressure, body weight was recorded for every individual.

Erythrocytes count and total leukocyte were counted according to the method describe elsewhere (Hameed ***et al.***, 1992). The haemoglobin level was determined by Sahli's method. (Dacie and Lewis, 1995).

Statistical analysis

The data is presented as Mean ± SD and was statistically analyzed by using the paired *t*-test at 95% confidence interval. All the statistical calculations were conducted with the help of Minitab™.

Results and Discussion

The mean age of the smoker (27±5.3 years) was not significantly different from the non-smokers (28.52±6.83 years). The mean body weight and blood pressure was also not significantly different between smokers and non-smokers, results are shown in Table 1.

The mean ± SD erythrocytes count of smokers (n = 100) was 5.26 ± 0.3584 million mm^{-3} with the range of 4.7 - 6.4 million mm^{-3} and of non-smokers was 5.444 ± 0.2966 million mm^{-3} (Table 1). The data in comparison with the control group (non-smokers) shows that smoking significantly decreases ($p < 0.02$) the erythrocytes level. In some smokers the erythrocytes level was below the normal physiological range. The linear regression analysis demonstrated the negative correlation ($r = -0.432$) between the number cigarettes smoked per day and erythrocyte count. The weak negative correlation ($r = -0.366$) was also observed between the period of smoking and the erythrocyte counts and smoking significantly decreases ($p < 0.002$) the erythrocyte count with passage of smoking period. This study revels that erythrocytes decreases with increasing the number of cigarettes smoked per day and period of smoking.

This study showed negative correlation between the erythrocyte level and number of cigarettes used per day and the length of smoking. The larger erythrocytes have been found in smoker compared with the non-smokers (Helman and Rubenstein, 1975). It is known that nicotine inhibits the function of erythrocytes, fibroblasts and macrophages. Schizophrenic patients who smoked had lower baseline erythrocyte (Hibbeln ***et al.***, 2003). It is suggested that smoking during pregnancy stimulates fetal erythropoeisis (D'Souza ***et al., 1978)***. The low erythrocyte count may lead to the number of physiological disorder and may also effects the efficiency of various enzymes hat may play role in the metabolism of the drugs.

The mean±SD total leukocytes count for smokers was 7183.33±1467.00 cell mm^{-3} (ranged between 4600-9400 cells mm^{-3}) was significantly higher ($p < 0.001$) compared with the non-smokers, 4903.70±377.70 cells mm^{-3} (Table 1). The linear regression model gave the positive correlation ($r = 0.43$) between the number of cigarettes smoked per day and increase in the total leukocytes count and increase in leukocyte count is significant ($p < 0.001$). The similar effects of the number cigarettes smoked per day on the leukocyte level also have been found elsewhere.

The period of smoking also demonstrated the positive correlation ($r = 0.313$) with the White cells count. The studies showed the persistent and significant ($p < 0.0001$) increase of white cells with the period of smoking the significant increase in leukocytes with even 10 cigarettes per day has been observed (Whitehead ***et al.***, 1995; Helman and Rubenstein, 1975). The increase in leukocytes in smoke-induced lung emphysema damage alveolar wall (Terashima ***et al.***, 1999). Increasing the number of cigarettes smoked per day not only raises the leukocyte count (Helman and Rubenstein, 1975, 1996) but also significantly ($p < 0.05$) depress the eosinophil level (Winkel, 1981).

Table 1: Age, body weight, Blood Pressure and Mean±SD Erythrocyte. Leukocyte, Haemoglobin level in Smokers and Non-Smokers

				Blood pressure				
		Age	Body			Erythrocytes*	Leukocytes**	Haemoglobin***
Group	n	year	weight	Systolic	diastolic	million mm^{-3}	cells mm^{-3}	g/100 ml
Smokers	48	27.1±5.3	68.75±8.92	116.88± 6.97	78.02±6.83	5.258±0.3584	7183.33±1467	13.26±0.809
Non-smokers	27	28.5±6.8	69.25±6.83	117.78±7.37	78.5±7.05	5.444±0.2966	4903.7±377.7	15.39±0.681

*p < 0.02, **p < 0.0001, ***p <0.05

The platelet-activating factor like mediators was found to accumulate in the blood of cigarette smoke-exposed hamsters (Lehr ***et al.***, 1997).

The haemoglobin level in smokers was 13.26 ± 0.81 g/100 ml with the range of 13.9-16.5 g/100 ml while in non-smokers was 15.38 ± 0.68 g/100, the level was significantly low ($p < 0.045$) in smokers compared with the non-smokers (Table 1). Linear regression model analysis showed the negative correlation ($r = - 0.573$) between the number of cigarettes smoked per day and this effect was significant ($p < 0.002$). Smoking for longer times steadily reduced the haemoglobin level and the correlation between these parameters was negative ($r = -0.455$) and smoking period significantly ($p < 0.0001$) reduces the haemoglobin level.

Cigarette smoking increases the activity erythrocyte glutathione peroxidase (L'abbe ***et al.***, 1992) and reduces the erythrocyte carbonic anhydrase activity (Abel ***et al.***, 1997). It has been found that the binding of bilirubin to the erythrocytes from healthy smokers as well as in vitro smoked erythrocytes is significantly higher than that of healthy non-smokers (Moin ***et al.***, 1998). Following smoking cessation, at least five years have to pass before changes in all hematological parameters may return to normal values (Van Tiel ***et al.***, 2002). Peroxide-mediated damage, including damage associated with iron-mediated free radical production, is increased after exposure to high concentrations of cigarette smoke (Mehlhorn, 2000).

These results suggest that antioxidant supplementation to smokers might be beneficial to decrease cellular oxidation damages (Durak ***et al.***, 2002)

In conclusion, smoking adversely affects the erythrocyte, leukocytes count and haemoglobin level. It decreases the erythrocytes count and haemoglobin level while increases the leukocytes. The number of cigarettes smoked per day and length of smoking period also adversely affects these parameters and may lead to various physiological disorders. It is suggested that social habits like smoking should be considered when interpreting the blood haematology values. The affect of smoking on enzyme also suggests that it may affect the drug metabolism; therefore during prescription the smoking may also be considered.

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