SEBHA UNIVERSITY JOURNAL OF JOURNAL OF MEDICAL SCIENCES VOL.18 NO. 1 2023
DOI: 10.51984/JOMS.V18I1.2637

مجلة جامعة سبها للعلوم الطبية
Journal of Medical Sciences

Journal homepage: www.sebhau.edu.ly/journal/index.php/joms

Cigarette smoking effects on biochemical and hematological parameter in Brack city in south Libya.

*Emmhamed Baled[1] & Ibrahim A. Mohamed[2]

[1]Department Of Medical Laboratory Sciences, Faculty Of Medical Technology, Al-Shatai University
[2] Department Of Biochemistry, Faculty Of Medicine, Sebha University

Keywords:
cigarette smoking
complete blood count (CBC)
liver function enzymes

A B S T R A C T

Introduction: Smoking is the worst human behavior; it is practiced by people addicted to nicotine. Cigarettes contain many harmful compounds, some of them implicated in different types of cancer. The effect of cigarette smoking can be shown in the disturbance of many biochemical and hematological processes detected by laboratory investigations. The aim of the present study is to evaluate the effect of cigarettes smoking on complete blood count (CBC) and liver function enzymes in smokers in city of Brack in southern Libya.

Materials and Methods: One hundred healthy males were volunteers to participate in the study. They were divided into two groups, 50 nonsmokers used as a control group, the other fifty were smokers. 5 ml of blood were withdrawn for the estimation of serum liver function enzymes; (alkaline phosphatase (ALP), alanine aminotransferase (ALT) and aspartate aminotransferase (AST) and CBC. Questionnaire and a consent form were used to collect general information.

Results: The result showed significant ($P<0.000$) increase in the activity of liver enzyme ALP, AST, AST in smokers compared to control group. Whereas ALT was significantly increased in smokers for more than ten years compared to those who smoked for less than ten years. A significant ($P<0.001$) increase found in MCV and WBC counts in smokers compared to control group.

Conclusion: cigarette smoking affected liver function detected by alterations in the activity of liver function enzymes and the change was dependent on smoking duration. Some blood count investigations were also changed.

تأثير تدخين السجائر علي المتغيرات الدموية و الكيوحيوية في مدينة براك جنوب ليبيا

*امحمد بلعيد شوية[1] و ابراهيم علي محمد[2]

[1] قسم علوم المختبرات الطبية ، كلية التكنولوجيا الطبية ، جامعة الشاطئ
[2] قسم الكيمياء الحيوية كلية الطب جامعة سبها

الكلمات المفتاحية:
تدخين السجائر
عد الدم الكامل
انزيمات الكبد

الملخص

التدخين أسوأ سلوك بشرى، يمارسه مدمني النيكوتين. تحتوى السجائر على العديد من المركبات الضارة، بعضها يتسبب في الإصابة بأنواع متعددة من السرطانات، ويظهر تأثير تدخين السجائر كاضطراب في العديد من العمليات الكيموحيوية والمتغيرات الدموية التي يمكن الكشف عنها من خلال الاختبارات المعملية. الهدف من هذه الدراسة هو تقييم مدى تأثير تدخين السجائر على تعداد الدم الكامل وإنزيمات الكبد لدى المدخنين في مدينة براك .

المواد والطرق: شارك فى هده الدراسة 100 متطوع من الذكور الأصحاء، تم تقسيمهم إلى مجموعتين، 50 غير مدخنين كمجموعة ضابطة و50 من المدخنين. تم سحب 5 مل من الدم لقياس إنزيمات الكبد) الفوسفتيز القلوى (ALP) والالانين امينوسفيراز (ALT) والاسبارتات امينوسفيراز (AST وتعداد الدم الكامل. تم استخدام الاستبيان واستمارة الموافقة لجمع المعلومات العامة .

*Corresponding author:
E-mail addresses: emm.allshwia@sebhau.edu.ly, (I. A. Mohamed) Ibr.eshnaf@sebhau.edu.ly
Article *History : Received 17 February 2023 - Received in revised form 07 June 2023 - Accepted 25 June 2023*

النتائج: أظهرت النتائج زيادة معنوية ذات دلالة إحصائية ($P<0.001$) في نشاط إنزيمات الكبد في المدخنين مقارنة بالمجموعة الضابطة، بينما ازداد إنزيم الالانين امينوسفيراز (ALT) بشكل ملحوظ لدى المدخنين لأكثر من 10 سنوات مقارنة بمن يدخنون لأقل من 10 سنوات. تم رصد زيادة ملحوظة ذات دلالة إحصائية ($P<0.001$)في قيمة متوسط حجم كرية الدم الحمراء وعدد خلايا الدم البيضاء لدى المدخنين مقارنة بالمجموعة الضابطة.

الخلاصة: تدخين السجائر يؤثر على وظائف الكبد والتي تم الكشف عنها بالتغيرات في نشاط إنزيمات الكبد وكان التغير يعتمد على مدة التدخين، كما لوحظ تغير في بعض المؤشرات الدموية.

Introduction

Although cigarette smoking had a devastating effect on human health, it still highly consumed throughout the world (Benowitz, etal., 1988). Smoking is one of the most common addictions of modern times. It has been implicated as an etiological agent for various chronic diseases, including a variety of infections, cancers, heart diseases and respiratory illnesses (Mehta etal., 2008; Zhong et al.,2008). Cigarettes contains over 4000 compounds, large quantities of oxidants and free radicals that induce oxidative stress (de Heens etal.,2009, Abel et al.,2005,Carel and Eviatar,1985). Moreover, cigarette smoking generates many toxic and carcinogenic compounds which are harmful to the health, such as nicotine, nitrogen oxides, carbon monoxide, hydrogen cyanide and free radicals (Hoffmann etal., 2001). World health organization reports indicated that the annual number of deaths in the world resulted from smoking was about five million persons and this number will be duplicated in the next twenty years (WHO,2010). Cigarette smoking is a major cause of preventable morbidity and mortality (Funck C, etal. 2006). Cigarette smoking yields chemical substances with high cytotoxic potentials (Yuen S.T,etal. 1995). Cigarette consists of many chemicals, including nicotine tar which was considered as carcinogens, and gaseous compounds including the toxic carbon monoxide. Large numbers of free radicals that is capable of initiating or promoting oxidative injury. Cigarette smoking causes a variety of adverse effects on organs that have no direct contact with the smoke itself such as liver, which is very important for storing glycogen, carbohydrate metabolism and the detoxification and elimination of compounds such as alcohol, toxic compounds and drugs from the human body(Yu,etal.1997, Passione,2001).

In a number of studies, it has been found that smokers have higher white blood cell counts than nonsmokers (Yarnell W et al, 1991, Wannamethee SG, 2005, Tiel D. etal, 2002).Numerous studies indicated that smoking had adverse effects on human health and represented a predisposing factor for development of various pathological conditions and diseases, such as the chronic obstructive pulmonary diseases, Cardiovascular, cancer (Buist AS, etal., 2008, Natalia paulina BK, etal.,2022, Moryson W and Stawinska-Witoszynska B.2021, Anna Rulkiewicz, etal 2021, David Marti-Aguado,etal,2022).The nicotine induces formation of a clot in the coronary arteries, it weakens the vascular activity, and increases endothelium dysfunction. Increase in the level of carboxyhemoglobin may cause hypoxia, and it is also responsible for sub-endothelial edema considering that it alters the vascular permeability and accumulation of lipids (Gosset LK, etal., 2009). (Yu M.W., et al, 1997**,** Pessione etal., 2001).

Smoking indirectly causes increased levels of carboxyhemoglobin which decrease oxygen loading capacity by RBC resulting in tissue hypoxia. Hypoxia leads to increased production of erythropoietin leading to hyperplasia of bone marrow. Also increasing of RBCs mass led to increasing of iron catabolism from aged RBCs and iron resulting from polycythemia, RBC catabolism from small intestine, all these factors lead to accumulation of iron in macrophage and hepatocyte and with time leads to increased oxidative stress of hepatocyte (El-Zayadi,2006). Toxic ingredients in cigarette smoke circulates throughout the body causing damage in many different ways leading to many health problems, manifested as hematological and physiological change seen in human body (Sasikala K, etal, 2003, Catterall JR, etal,1985).

Materials and Methods

Subjects:-

Total of (100) subjects were recruited to the present study during their attendance of outpatient clinics at the central hospital in Brack city South of Libya. They were divided into two groups; 50 smokers and 50 nonsmokers. Their ages were ranged from 18to70 years, their cigarettes consumption per day was 19-28 cigarettes. All subjects agreed to participate in a comprehensive self-administered questionnaire survey about smoking and signed a consent form.

Sample:

Five ml blood sample was withdrawn from each subject, collected in disposable plastic tubes divided in two parts, the first 2 ml was emptied in plain tube without the anticoagulant to measure liver enzyme and other contains EDTA anticoagulants to conduct a CBC test.

CBC was measured using Sysmex auto-analyzer.7parameters were measured including hemoglobin (Hb), red blood cell count (RBCs), white blood cells count (WBCs), platelets count (PLT), hematocrit (HCT), Mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC).

The plain tube sample was allowed to clot at room temperature for 20 minutes. The serum was separated by centrifugation at 3000 rpm for 10 minutes and transferred to another empty tube. The separated serum was used to measure the liver enzymes (ALT, AST and ALP) using readymade Kits from Biomaghreb company.

Statistical analysis:

All the analysis was done using Microsoft office excel 2013 and Windows based Minitab 16 statistical package. The generated data analyzed into percentage, variant increase and decreases, mean± standard deviation (SD), were calculated. Paired t test was used to compare between smokers and nonsmokers and a p-values < 0.05 were taken as the level of significance.

Result:

CBC results are shown in table 1. It shows a significant difference in the WBCs count and the mean corpuscular value between smokers and control group.

Cigarette smoking caused a significant increase in the mean ± SD of white blood cell count and mean corpuscular volume[6.68±2.39($\times10^9$/L)&97.57±5.66(fL)], compared to nonsmokers [5.38±1.55($\times10^9$/L)&97.57±5.66(fL)]respectively. The increase in hemoglobin values (14.02±1.29 g/dl) in the smokers but not significant of hemoglobin compared to non-smokers (hemoglobin: 13.87±1.76g/dl). The hematocrit values(48.48±3.88 %) was increased non-significantly in smokers compared to nonsmokers (47.56±5.88%).In the same way, platelet count [241.68±56.53($\times10^9$/L)]for smokers was non-significantly increased compared to nonsmokers [229.70±56.88($\times10^9$/L)]. The results also showed that there is no difference between smoker and nonsmokers, total count of red blood cell(RBCs) and the mean corpuscular hemoglobin concentration(MCHC).

Table (1):The effect of cigarette smoking on some hematological parameters between smoker and nonsmoker population.

Parameters	Nonsmokers (M±SD)	Smokers (M±SD)	P-value
WBC($\times10^9$/L)	5.38±1.55	6.68 ±2.39	0.002
Hb (g/dl)	13.87±1.76	14.02±1.29	0.649
RBC($\times10^{12}$/L)	5.07±0.59	5.00±0.43	0.510
HCT(%)	47.56±5.88	48.48±3.88	0.204
MCV(fL)	94.99±6.29	97.57±5.66	0.035

MCHC(g/dL)	28.72±1.11	28.62±0.60	0.586
PLT(×10^9/L)	229.70±56.88	241.68±56.53	0.286

(Whereas; fL stands for femtoliter).

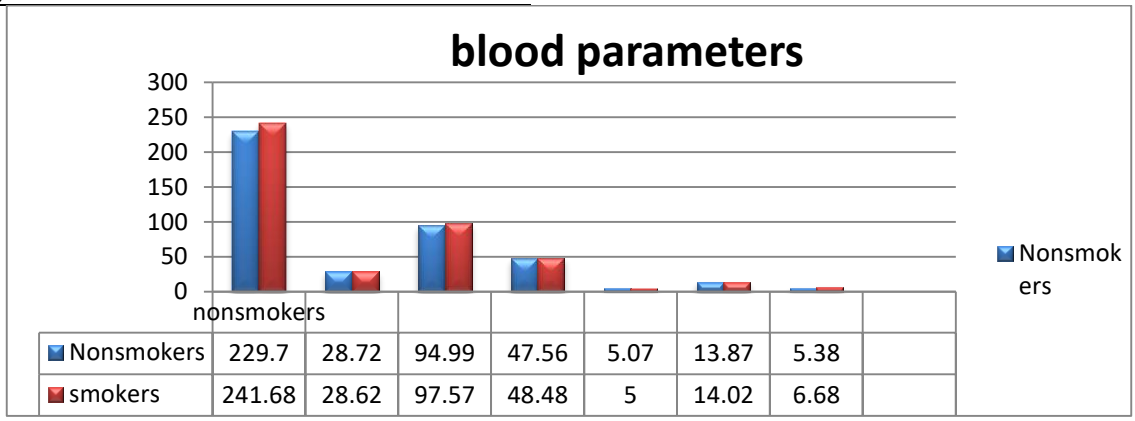

Figure1: The effect of cigarette smoking on some hematological parameters between smoker and nonsmoker population.

The comparison between liver enzymes of smokers and nonsmoker are showed in **table 2**. enzyme activities of ALP, ALT and AST of the smokers; 310.06±99.11 U/l, 47.66±19.89 U/l and 47.26±21.51 U/l, respectively, were highly significant (p<0.000) increased compared to that of the nonsmokers; 155.84±68.29 U/l,31.50± 6.41 U/l and 26.89±7.70 U/l.

Table (2):The effect of cigarette smoking on liver function between smoker and nonsmoker population.

Parameters	**Nonsmokers (M±SD)**	**Smokers (M ± SD)**	**P-value**
ALP (U/L)	155.84±68.29	310.06±99.11	0.000
ALT(U/L)	31.50±6.41	47.66±16.89	0.000
AST(U/L)	26.89±7.70	47.26±21.51	0.000

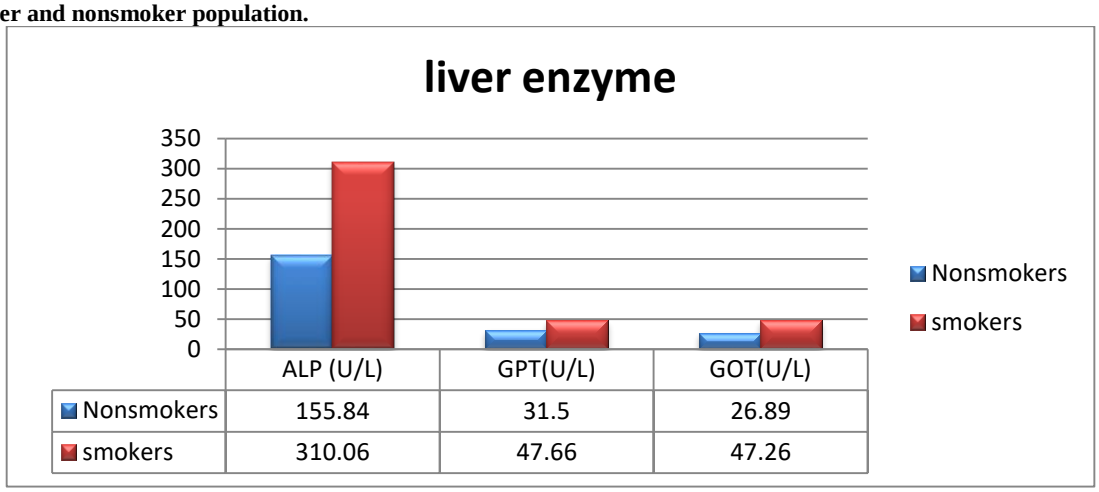

Figure 2: The effect of cigarette smoking on liver function between smoker and nonsmoker population.

In regard to the hematological parameters, the present work showed that there was significant (p<0.05) decrease in the mean corpuscular volume (MCV) in the smokers for 1-10 years [94.81±4.20 (fL)] compared to smokers for more than ten years [98.81±5.74 (fL)]. On the contrary, there was non-significant increase in the white blood cell counts 7.15±3.20(×10^9/L), total red blood cell5.16±0.44(×10^{12}/L)of the smokers for1-10 years compared to the smokers for more than ten years 6.48±1.93(×10^9/L), 4.91±0.33(×10^{12}/L), respectively., there was no significant change in hemoglobin (13.97±1.40 g/dl), hematocrit (48.86±4.17%) mean corpuscular hemoglobin concentration [28.51±0.61(g/dL)] in the smokers for ten years when compared to the smoker more than ten years [(13.99±1.220g/dl),(48.69±3.62%) and (28.65±0.59(g/dL)] respectively. On the other hand, there was non-significant decrease in platelet count [232.73±59.46 (×10^9)] in smokers for ten years compared to smoker for more than ten years [245.47±55.48 (×10^9)].Table (3): shows the results of the group of smokers for ten years and more compared to smokers for duration of 1-10 years.

Table (3):The effect of cigarette smoking on some hematological parameters between smokers more than 10 years and smokers for 1-10 years.

Parameters	**Smokers> 10 years(M±SD)**	**Smokers< 10 years M±SD**	**P-value**
WBC(×10^9/L)	6.48±1.93	7.15±3.20	0.477
HGB(g/dl)	13.99±1.22	13.97±1.40	0.948
RBC(×10^{12}/L)	4.91±0.33	5.16±0.44	0.066
HCT(%)	48.69±3.62	48.86±4.17	0.838
MCV(fL)	98.88±5.74	94.81±4.20	0.013
MCHC(g/dL)	28.65±0.59	28.51±0.61	0.562
PLT(×10^9)	245.47±55.48	232.73±59.46	0.660

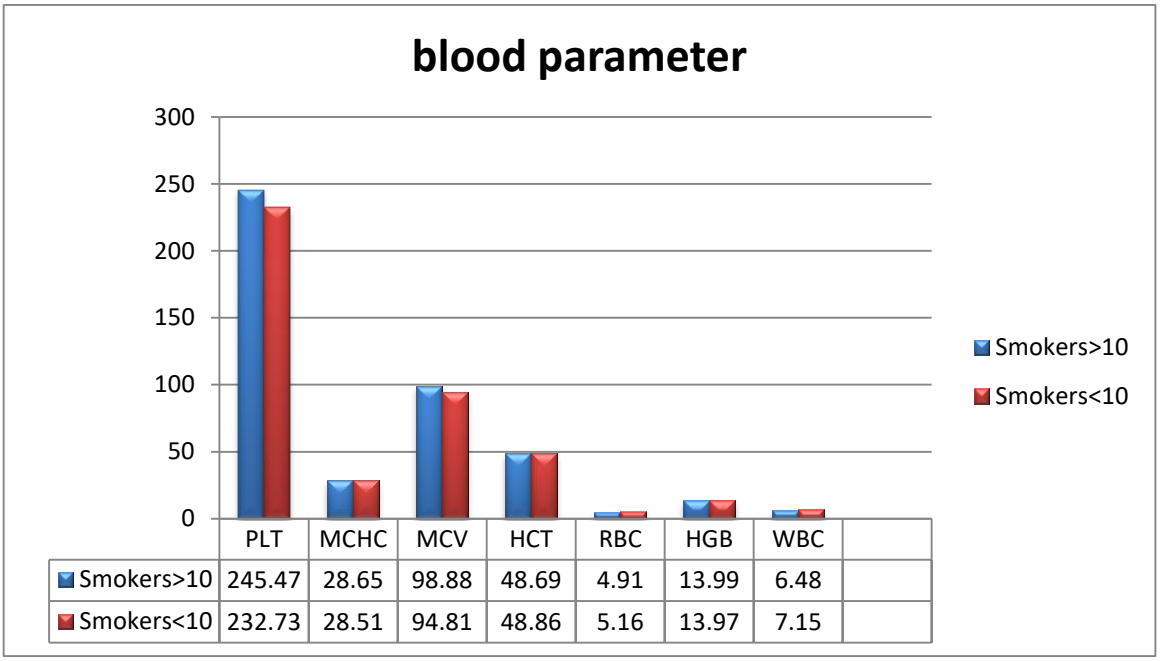

Figure3: The effect of cigarette smoking on some hematological parameters between smokers for more than ten years and Smokers for ten years

Regarding the ALP and transaminases (ALT and AST), the present work showed an non-significant increase in serum ALP (327.87±97.25 U/l) and AST (50.26±24.10 U/l) level in smokers for more than ten years when compared with smokers for less than ten years (ALP= 268.00±93.64 U/l) and (AST= 40.75±12.71 U/l). On the other hand, serum ALT activity(50.62±18.52U/l) was significantly(P value<0.05) increased in smokers for more than ten years compared to ALT activity(41.40±10.68 U/l) in smokers for less than ten years (**table 4).**

Table (4):The effect of cigarette smoking on liver function between smoker for more than ten years and Smokers for ten years.

Parameters	**Smokers> 10years (M±SD)**	**Smokers< 10 years (M±SD)**	P-value
ALP(U/L)	327.87±97.25	268.00±93.64	0.061
ALT(U/L)	50.62±18.52	41.40±10.68	0.040
AST(U/L)	50.26±24.10	40.75±12.71	0.134

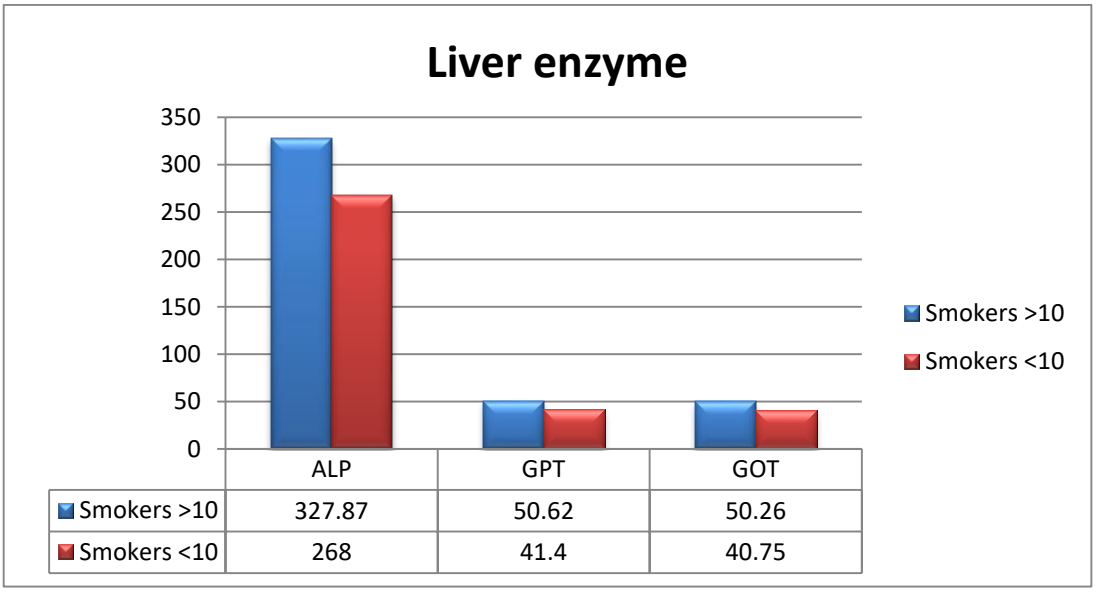

Figure 4: The effect of cigarette smoking on liver function between smokers for more than ten years and Smokers for ten years.

Discussion:

Approximately, ten percent of the human mortality in 2012 resulted from smoking. To date, millions have died due to conditions-linked to smoking and this rate expected to reach eight million by 2030 (Murray and Lopez, 1997 & Mathers and Loncar, 2006). There are 4000 substances in a single cigarette, 200 of which are poisonous and 80 causes cancer; such poisonous substances include nitrogen oxide, nicotine, hydrogen cyanide, carbon monoxide and free radicals which result in disorders in the human body (Farsolinos ,et al, 2013).

Cigarette smoking contains over 4000 different chemicals, 400 of which are proven to be carcinogenic, (Yeh,et al,2008) many toxic substances especially reactive oxygen species (ROS) such as superoxide anions, hydroxyl radicals, H_2O_2 and HOCL present in smoke can damage cellular constituents leading to inflammation and injury (Marnett, etal, 2003and Kopa, P.N., and Pawliczak, R, 2020.), the results of our findings showed that cigarette smoking has adverse effects on hematological parameters.

The current work showed alterations in hematological parameters of smokers compared to nonsmokers; included significantly high levels of WBC(P value=0.002)and MCV(P value =0.035)in smokers compared to nonsmokers. On the other hand, the values of Hb, RBCs, MCHC, HCT and PLT did not demonstrate any significant change in smoker group compared to nonsmoker group. These findings were in agreement with (Pankal, etal, 2014 and Malenica,etal, 2017).and not agreement with (Nazia Siddiquil,etal,2023 and Roethig, etal, 2010) who found significant raised in these parameters in smokers group.

The present study showed changes in hematological parameters of smokers and nonsmokers in group ten years and more than ten years

which demonstrate significantly increase in MCV P value= 0.05, on the other hand increase in PLT in more than ten years and increase in WBC and RBC in ten years were the HCT , HB , MCHC showed no significant different between the smoker than ten years and smoker ten years respectively. The higher value of hematocrit as observed by our study are favored by other studies (Hassan A, etal, 2012 and Jayballabh, etal, 2013). WBC were significantly elevated in cigarette smokers when compared with nonsmokers P< 0.002. similar findings observed by other authors (Wojtyla, etal,2012, Watanabe, 2011, Inal,etal, 2014 and Higuchi, etal, 2016). However other authors reported elevation of WBC counts. In addition, there was elevation in neutrophils and lymphocytes(Tanasan, etal,2012).

Aitchison, R,1988 and Verma, RJ, 2015 reported that nicotine and inflammatory stimulation of the bronchial tract induces an increase in inflammatory markers in the blood circulation and increase lymphocyte count, where inflammatory causes Neutrophile leukocytosis (Hoffbrand& Pettit,2016). Increase MCV in our study indicates that subjects might suffer from anemia caused by iron and folic acid deficiencies. Nitrous oxide causes abnormalities of vitaminB12 and folate metabolism and liver disease causes excess urinary folate loss(Hoffbrand&Pettit,2016).

higher level of hematocrit and hemoglobin have been demonstrated in smokers and these increases are likely to be compensatory for exposure to carbon monoxide which causes secondary erythrocytosis (Hoffbrand& Pettit,2016 and Roethig,etal,2010). Increase in smoking can cause endothelial damage leads to increase the PLT count. Moreover, the platelet production is controlled by hormonal metabolisms may be potentially impaired via smoking causing production of platelets and increased platelet count.(Lupia, etal,2010).

Liver is considered as one of most important body organs, which has many detoxifications and other important functions such as metabolism of drugs and alcohol, toxins(Pessione et al, 2001).The liver function tests are useful to check if there is any alterations in the liver function. Relating to the two enzymes(ALT and AST), their levels are raised in the liver that is damaged by the hepatocellular disease which cause injury in the liver cells, that increases the level of the two enzymes in blood stream (Wannamethee, 2008 and Etter, 2011). Some investigators proved ALP was increased by smoking (Astle, 2005, Schreiner,A.D. etal.(2018)and **M**usa,A.H. etal.(2022) while recent studies argued that smoking did not influence GPT or ALP (Mohammed Mousa Atta, 2019 Ugbor, C.L.etal. (2013) and Suriyaprom, K etal.(2007).

In our study we found mean serum ALP, ALT and AST were significantly increase in smoker than in nonsmoker (p=0.000). As showed in table (2). Al-Hamdani, 2007, proved that the smoking led to increasing in the activity of liver enzyme due to its content of nicotine tar, free radicals which lead to increase its concentration, this is in agreement with our result.

Our results showed that ALT have significantly increase in smokers more than ten years , where ALP and AST have high level increase in smokers more than ten years, when compare them with smokers ten years. According to these results, the elevation in the levels of (ALT) and (AST) because of the effectiveness of the smoke and its harmful chemical compounds on liver cells that lead to the liver cell secretion to these enzymes through inflammatory pathways or due aggravate the pathogenic effects of others compounds in cigarette on the liver (Farsalinos, etal. 2013). Regarding serum liver enzyme level, our study is in accordance with (Enaam Ahmed Hamza Al-Dagestani, (2021) who on further analysis found that serum liver enzyme level was significantly high in smoker (p<0.000).

Some investigators proved that ALP was increased by smoking (Astle. 2005), as our results support, while other studies argued that smoking did not influence AST or ALP (Suriyaprom, et al., 2007& Whitehead. etal., 1996; Tajima et al., 1988). A possible explanation for increased transaminase levels in smokers is the synergistic effects between smoking and oxidative stress. This assumption is further supported by the significantly higher ALP of our study. Serum levels of liver enzymes increased according to the degree of damage of the liver cells; these enzymes include amino transferases.

ALT and ALP enzymes frequently appear in the serum following liver cell injury or sometimes in smaller amounts from degraded cells (Raja, MM. et al, 2011). Smoking cigarettes can also severely affect your liver, the numerous toxins found in cigarette lead to chronic inflammation and scarring in the liver (Kopa, P.N, and Pawliczak, R, 2020). Cigarette smoke increase the lipid peroxidation, which damage biological cell membrane of the liver and serum aminotransferases are enzymes that act as sensitive indicators of hepatocellular damage (Rochling, 2001). From our results, it can be suggested that cigarette smoke contain many potential hepatotoxic substances which affect liver function through its effect on liver enzyme. From the present study, we can conclude that continuous cigarette smoking can affect liver functions, through its effect on serum ALP, ALT, AST and alterations in hematological parameter WBC, MCV, HB, HCT and PLT, when compared with nonsmoking and these alterations might be associated with a greater risk for developing atherosclerosis, Polycythaemia vera and chronic obstructive pulmonary disease.

Acknowledgments; author would like to thank all subject who participated in the study, as well as the staff at the central hospital in Brack.

Reference:

Abel, G. A., Hays, J. T., Decker, P. A., Croghan, G. A., Kuter, D. J., Rigotti, N. A. (2005). Effects of biochemically confirmed smoking cessation on white blood cell count. Mayo. Clin. Proc; 80(8): 1022-1028.

Aitchison, R., Russell, N.(1988). Smoking a major cause of polycythaemia. Journal of the Royal Society of Medicine; 81(2): 89-91.

Al-Hamdani, I.H. (2007). Biochemical, changes of serum liver Enzyme (Aspartate Aminotransferase, Alanine Aminotransferase and Alkalinephosphatase) in cigarette smokers in Mosul. Tikrit Medical Journal; 13.161-165.

Anna Rulkiewicz, Iwona Pilchowska, Wojciech Lisik , Piotr Pruszczyk and Justyna Domienik-Karłowicz.(2021).Prevalence of Cigarette Smoking among Professionally Active Adult Population in Poland and Its Strong Relationship with Cardiovascular Co-Morbidities-POL-O-CARIA Study. J. Clin. Med; 11, 4111.

Astle, S. (2005). Restoring Electrolyte Balance. Rn., 68: 34-40.Aurelio, L. Biochemical Markers Of Cardiovascular Damage From Tabacco Smoker. Cuur. Pharm. Des; 11:2190-2208.

Benowitz, N. L., Porchet, H., Sheiner, L., Jacob, P. (1988). Nicotine absorption and cardiovascular effects with smokeless tobacco use: comparison with cigarettes and nicotine gum. Clinical pharmacology and therapeutics; 44(1): 23-28.

Buist, A.S., Vollmer, W.M., McBurnie, M.A.(2008). Worldwide burden of COPD.in high- and low-income countries. Part I. The Burden of Obstructive.Lung Disease (BOLD)Initiative. Int J Tuberc Lung Dis;12:703 .8.

Carel, R. S., Eviatar, J. (1985). Factors affecting leukocyte count in healthy adults. Prev. Med; 14(5): 607-619.

Catterall, J.R., Calverley, P.M., MacNee,W., Warren,P.M., Shapiro, C.M., Douglas, N.J., Flenley, D.C.(1985). Mechanism of transient nocturnal hypoxemia in hypoxic chronic bronchitis and emphysema. J.Appl.Physiol. Dec;59(6):1698-703.

David Marti-Aguado, Ana Clemente-Sanchez, Ramon Bataller.(2022). Cigarette smoking and liver diseases**.** Journal of Hepatology ; vol. 77 j 191–205

de Heens, G. L., Kikkert, R., Aarden, L. A., Van der Velden, U., Loos, B. G).(2009). Effects of smoking on the ex vivo cytokineproduction in periodontitis . J. Periodontal. Res; 44(1): 28-34.

El-Zayadi, A.R.(2006). Heavy smoking and liver. World J Gastroenterol ;12:6098-6101.

Enaam Ahmed Hamza Al-Dagestani. (2021),Study of the Biochemical Markers of Liver and Renal Function in Moderate -To-Heavy Cigarette Smokers' Men in Mosul Cit**.**Indian Journal of Forensic Medicine & Toxicology; January-March; Vol. 15, No.1.

Etter, J., Bullen, C. (2011) .Cigarette: users profile, utilization, satisfaction and perceived efficacy. Addiction; 106: 2017–2028

Farsalinos, K., Romagna, G., Allifranchini, E., Ripamonti, E., Bocchietto E., Todeschi, S., et al.(2013) Comparison of the cytotoxic potential of cigarette smoke cigarette vapour extract on cultured myocardial cells. Int J Environ Res Public Health; 10: 5146–5162.

Funck C., Mathilde, R., Michel, L., Arnould, J., Verstuyft, C., Martine, L., et al.(2006). Effects of type of smoking (pipe, cigars or cigarettes) on biological indices of tobacco exposure and toxicity. Lung Cancer;54: 11–8.

Gossett, L.K., Johnson, H.M., Piper, M.E., Fiore, M.C., Baker,T.B.,Stein, J.H. (2009).Smoking intensity and lipoprotein abnormalities in active smokers. Journal of clinical lipidology; 3(6): 372-8.

Hassan, A., Almarshad, F.M., Hassan.(2012).The Hemorheological properties of blood among Saudi male Smokers in Sakaka city, Aljouf, Saudi Arabia. South Asian Journal of Family Medicine ; 3:14-17

Higuchi, T., Omata, F., Tsuchihashi, K., Higashioka, K., Koyamada,R.,Okada, S. (2016).Current cigarette smoking is a reversible cause of elevatedwhite blood cell count: Cross-sectional and longitudinal studies. Preventive medicine reports ; 4: 417-22.

HoffbrandA.V& Pettit J.E: Essential Hematology; 7th edition, (2016), Blackwell Science. Oxford.

Hoffmann, D., Hoffmann, I., El-Bayoumy, K. (2014). The less harmful cigarette: a controversial issue. a tribute to Ernst L. Wynder. Chem. Res. Toxicol; 14(7): 767-790.

Inal, B., Hacibekiroglu, T., Cavus, B., Musaoglu, Z., Demir, H., Karadag, B.(2014). Effects of smoking on healthy young men's hematologic parameters Northern clinics of Istanbul ; 1(1): 19-25.

Jayballabh, K., Gaurav, K., Abhishek. S., Farhan, A., Sanjeev, S.(2013). The Effect Of Smoking On The Blood Parameters Of Young Adults. Journal of Clinical and Diagnostic Research ; 6:1244-1247.

Kopa, P.N., and Pawliczak R.(2020). IQOS – a heat-not-burn (HnB) tobacco product–chemical composition and possible impact on oxidative stress and inflmmatory response. A systematic review. Toxicol Mech Methods; 30:81–87.

Lupia, E., Bosco, O., Montrucchio, G. (2010).Thrombopoietin contributes to enhanced platelet activation in cigarette smokers. Atherosclerosis; 314-319.

Malenica,M. Besim,P.,Tamer,B., Tania,D., etal.2017. Effect of Cigarette Smoking on Haematological Parameters in Healthy Population;Med Arch. Apr, 71(2) 132-136.

Marnett, L.J., Riggins, N.J., West. J.D.(2003). Endogenous generation of reactive oxidants and electrophiles and their reaction with DNA and protein. L Clin Invest ; 111:583-93.

Mathers, C.D., and Loncar, D.(2006). Projections of global mortality anburden of disease from 2002 to 2030. PLoS Med; 3(11):442-443.

Mehta, H., Nazzal, K., Sadikot, R. T. (2008). Cigarette smoking and innate immunity. Inflamm. Res; 57(11): 497-503.

Mohammed Mousa Atta, Saad GhabanHussain, and Adnan Jawad Ahmed.(2019). Effect of Cigarett smoking on the activity of liver enzyme (AST,ALT, ALP). Plant Archives Vol. 19 No. 1, pp. 1874-1880.

Moryson W., Stawinska-Witoszynska B.(2021). Premature Mortality Due to Tobacco- Related Malignancies in Poland. Int J Gen Med.;14:2171- 2182.

Murray, C.J., and Lopez, A.D. (1997). Alternative projections of mortality and disability by cause 1990-2020. Global Burden of Dis Study;349(9064):1498-1504.

Musa,A.H.,Abdulmagjid, L.A.,Haruna,B.A., Ismaila,J .(2022). Effect of Chronic Consumption of Smokeless Tobacco(snuff) on Liver Enzymes of males in Maiduguri, Northeast Nigeri Sokoto. Journal of Medical Laboratory Science; 7(1): 107-114.

Natalia Paulina Bielecka-Kowalska1,A.C. , Sandra Bielicka1,B.D ., Natalia Lewkowicz1,E. (2022). Effects of tobacco smoking and electronic nicotine delivery systems on oral health – a narrative review. Journal of Pre-Clinical and Clinical Research; Vol 16, No 3

Nazia Siddiqui1, Shahida Mushtaq, Sunia Ghaffar, Ambreen Zafar, Sabahat Rehman, Fareeha Aleem, Farhat Abbas Bhatti.(2023). Variation in hematological parameters due to tobacco cigarette smoking in healthy male individuals. Professional Med J;30(02):264-269.

Panka,J, Reena J.,Ketan,M.(2014). Effect of cigarette Smoking on Haematological Parameters:comparison between male smokers and non smokers. I J SN, 5(4):740-3

Pessione, F., Ramond, M.J., Njapoum, C., Duchatelle, V., Degott, C., Erlinger, S., et al.(2001).Cigarette smoking and hepatic lesions in patients with chronic hepatitis C. Hepatology; 34: 121 -5.

Raja, M.M., Raja, A., Imran, M.M., Santha, A.M., Devasena, K.(2011). Enzymes Application in Diagnostic Prospects. Enzymes Application in Diagnostic Prospects. Biotechnology; 10: 51-59.

Rochling, F. A. (2001). Evaluation of abnormal liver tests. Clin. Corner-stone;3(6): 1-12.

Roethig, H.J., Koval, T., Muhammad-Kah, R., Jin, Y., Mendes, P.,Unverdorben, M.(2010). Short term effects of reduced exposure to cigarette smoke on white blood cells, platelets and red blood cells in adult cigarette smokers. RegulToxicolPharmacol;57:333–337.

Sasikala, K., Rosalin, F.R., Jude, A.L.C., Kumar, R.A., Sudha, S., Devi, M.V., Balachandar, N., Beegam, K.A.S., Meenakshi, N. and Begum, A. (2003).Active and Passive Smokers - A Haematobiochemical and Cytogenetic Study. Int J Hum Genet ;3(1):29-32.

Schreiner,A.D.,Rockey,D.C.(2018).Evaluation of abnormal Liver tests in the adult asymptomatic patient. Curr. Opin. Gastroenterol. 34, 272-279.

Suriyaprom, K., Hamrnroongroj, T.,Namjuntra, P., Chantaranipapong, Y., Tungtrongchitr, R. (2007). Effects of tobacco smoking on alph-2-macroglobulin and some biochemical parameters in Thaimales. Southeast Asian J. Trop. Med. Public Health; 38(5):918-926.

Tajima, K., Takeuchi, K., Suzuki, S. (1988). Risk factors for liver dysfunc-tion in middle aged men based on four year health examination data. Journal of occupational health; 40(4): 339-344.

Tanasan, S., Kanjana, S., and Prapai, H. (2012). The Effects of Cigarette Smoking on Red Blood Cell Hemolysis, Antigen and Antibody Titer of ABO and RhSystem and Hematological Parameters , J Med Tech Assoc Thailand d, vol. 40 No l 075-080

Tiel, D., Van, E.L., Peeters, H.M.P., Smit, A.H., Nagelderke, J.D.N., Loon,M.V., et al.(2002). Quitting smoking may restore hematological characteristics.within five years. Ann Epidemiol ; 12:378-388.

Ugbor, C.I., Okogun, G.R.A., Okonkwo, L.O., EzeN.C., Asogwa, B.E., Ebo, J.O., Maduagwuna, G.N., Ekoh, S.N. (2013). The Effect ofTobacco, Snuff Consumption on Liver Enzymes. International Journal of Herbs and, PharmacologicalResearch; 2(2): 20 –27

Verma, R.J., Patel, C,S.(2015). Effect of smoking on Haematological parameters in Human Beings. Journal of Cell and Tissue Research; 5(1): 337.

Wannamethee, S.G., Lowe, G.D., Shaper, A.G., Rumley, A., Lennon,.L., et al.(2005). Association between cigarette smoking, pipe/cigar.smoking, and smoking cessation, haemostatic and inflammatory.markers for cardiovascular disease. Eur Heart J ;26(17):1765-1773.

Wannamethee, S.G., Shaper, A.G.(2008). Cigarette smoking and serum liver enzymes:the role of alcohol and inflammation .Int J Epidemiol.36:435-78

Watanabe, N., Fukushima, M., Taniguchi, A., et al.(2011). Smoking, white blood cell counts, and TNF system activity in Japanese male subjects with normal glucose tolerance. TobInduc Dis ;9(1):12.

Whitehead, T. P., Robinson, D., Allaway, S. L. (1996). The effects of cigarette smoking and alcohol consumption on serum liver enzyme activities: a dose-related study in men. Annals of clinical biochemistry: An international journal of biochemistry and laboratory medicine; 33(6): 530-535.

Wojtyła, C., Głuszek, Ł., Biliński, P., Paprzycki, P., Warzocha, K.(2012). Smoking during pregnancy--hematological observations in pregnant women and their newborns after delivery. Annals of Agricultural and Environmental Medicine: AAEM ;19:836-841.

World Health Organisation, (2010). WHO Regulatory consultation on the safety of Electronic Nicotine Delivery Devices (ENDS) world health organisation Geneva.

Yarnell, J.W., Baker, I.A., Sweetnam, P.M., Bainton, D., Obrien,J.R.,et al.(1991).Fibrinogen, viscosity and white blood cell count are major.risk factors for ischemic heart disease. The CaerphillyandSpeedwell collaborative heart disease studies. Circulation;83:836-844.

Yeh, C., Graham, B., Powell C., Mesia-Vela, S., Wang, Y., Hamade,

N., et al. (2008). Effect of cigarette smoking dose on oxidized plasma proteins. Environ. Res ; 106: 219–25.

Yu, M.W., Hsu, F.C., Sheen, I.S., Chu, C.M., Lin, D.Y., Chen, C.J., et al.(1997). Prospective study of hepatocellular carcinoma and liver cirrhosis in as-ymptomatic chronic hepatitis B virus carriers. Am J Epidemiol;145: 1039-47.

Yuen, S.T., Gogo, A.R., Luk, I.S., Cho, C.H., Ho, J.C., and Loh, T.T.(1995).The effect of nicotine and its interaction with carbon tetrachloride in the rat liver. Pharmacol. Toxicol ; 77: 225–30.

Zhong, C. Y., Zhou, Y. M., Pinkerton, K. E. (2008). NF-kappaB inhibition is involved in tobacco smoke-induced apoptosis in the lungs of rats. Toxicol. Appl. Pharmacol; 230(2): 150-158.