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Study Effect of Cigarette Smoking on the Liver Functions and Electrolytes

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Abstract

Smoking have a direct and indirect effects on some organs of the body, this effect is duo to inhaled the smoke and reach the alveoli and in to pulmonary veins. The main objective of this study, to investigate the changes in liver enzymes Alanine aminotransferase(ALT), Aspartate aminotransferase(AST) and Alkaline phosphatase(ALP) and electrolytes like(K^+, Na^+, Fe^{+2}, Ca^{+2},Cl^- and Po_4^{-3}) in male smokers. In this study collect of (100) blood samples from male smokers and divided in to (3) groups according to period of smoking, and compare with (40) nonsmoker persons (group 4), the age groups are between (25-40) year, in a period between (November 2015-April 2016), within the district of Baqubah in Diyala governorate .The results show increase activity of enzymes ALT, AST and ALP ($p<0.001$) in smokers compared to control, and no significant differences in the electrolytes (K^+, Na^+, Cl^-) but a significant decrease in Ca^{+2} level ($p<0.001$), while the iron concentration increased significantly in all smokers, and the phosphorus concentration increased significantly ($p<0.001$) in two groups of smokers (10-20) years period of smoking. From this study showed a significant effects on the activity of liver enzymes, Ca^{+2}, Po_4^{-3} and Fe^{+2}in smokers compare to non-smokers while no significant effect on the Sodium, Chloride and Potassium in smokers.

Keywords: Liver enzyme, Electrolyte, Cigarette smoking, Hepatic disease, Coronary heart disease.

دراســـة تأثير التدخين على وظائف الكبد والشوارد الكيميائية

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الخلاصـــة

للتدخين تأثيرات مباشرة وغير مباشرة على معظم أعضاء الجسم. هذه التأثيرات يمكن ان تحدث بسرعة عندما تستنشق وتصل الى الحويصلات الرئوية ومن ثم الى الاوردة الرئوية. الهدف من الدراسة هو التحري عن التغير في مستويات الانزيمات الكبدية مثل الانين ، امينوترانسفيريز و اسبرتيت امينوترانسفيريز و الكلاين فوسفتيز و الشوارد الكيميائية مثل البوتاسيوم والصوديوم و الحديد و الكالسيوم و الكلوريد و الفوسفات في مصل دم المدخنين الذكور.

تم جمع 100 عينة من المدخنين الذكور وتم تقسيمها الى ثلاث مجاميع اعتمادا على فترة التدخين. ومقارنتها مع 40 شخص غير مدخن (مجموعة رابعة) والاعمار المختارة هي بين (25 – 40 سنة) من الفترة ما بين (تشرين ثاني 2015 – نيسان 2016) في قضاء بعقوبة في محافظة ديالى.

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وتبين من النتائج زيادة فعالية الانزيمات الكبدية ALT ، AST،ALP (P < 0.001) لدى المدخنين مقارنة بغير المدخنين. وأيضا لا توجد اختلافات مهمة في مستويات الشوارد الكيميائية مثل البوتاسيوم و الصوديوم و الكلوريد في مصل الدم ، وأيضا هناك نقص ملحوظ بنسبة الكالسيوم.

بينما هناك زيادة معنوية (P < 0.001) بنسب الحديد لدى المدخنين مقارنة بغير المدخنين وان هناك زيادة معنوية (P < 0.001) بنسب الفوسفات بمجموعتين من المدخنين (من10 – 20 سنة) من الاعمار مقارنة بغير المدخنين. وأيضا تبين ان هناك تأثيرات معنوية على فعالية الانزيمات الكبدية والكالسيوم والفوسفات والحديد لدى المدخنين مقارنة بغير المدخنين. بينما لا يوجد تأثير معنوي على الصوديوم والكلوريد والبوتاسيوم لدى المدخنين،

Introduction

The smoke of the cigarette contain (4000) harmful chemical materials, 400 of this materials are carcinogenic, also contain different oxidants like oxygen free radicals and volatile aldehydes which are responsible to cause damage to biomolecules [1].

Cigarette smoking has indirect effects on other organs such as the liver which have many functions there for it is an important organ, which is responsible to protect the human body from harmful materials like drugs, alcohol, and other toxic agents [2, 3].

Smoking are more risky to cause cardiac and respiratory diseases with hepatic disease, also consider as a carcinogenic agent [4]. The free radicals cause defect in DNA proteins, cell membrane and oxidative effects, which implicated in the pathogenesis as reported in [5].

In this study measure the important enzymes like aspartate aminotransferase (AST), alanine aminotransferase(ALT) and alkaline phosphatase(ALP), the functions of the ALT and AST are to transfer the amino group, the aspartate and alanine to ketoacid, and producing oxaloacetate and pyruvate. The electrolytes present as catalysts in cellular enzymes and have a major role in the metabolism. The functions of the electrolytes are to regular the fluids in the body, maintain normal acid base balance, blood clotting, muscles contractions and have a major role in nerve conduction as reported in [6].

Electrolyte disturbance also can lead to hepatic disease, coronary heart disease, renal failure and endocrine disorders. [7, 8].

The main objective of study, to investigate the changes in liver enzymes (ALT, AST, ALP) and electrolytes like (K^+, Na^+, Fe^{+2}, Ca^{+2}, Cl^-, Po_4^{-3}).

Materials and method

One hundred fourty male smokers was taken in this study from Baaquba district, (100 cases smokers and 40 non-smokers as control).The age is between (25-40) years, the smokers divided in to three groups (5-10), (10-20 and >20) years depending on the smoking duration.. , 5 ml of blood samples collected from each case in test tube and after 30 minutes. The serum separated by centrifuge to measure the liver enzymes and electrolytes levels. The levels of statistical significant analysis was ($p<0.05$), ($p<0.01$), ($p<0.001$).

Results and discussion

Cigarette smoking was significantly associated with increased levels of ALT, AST, ALP($P<0.001$) compared with control as shown in (Table-1).

Table 1- The activity of serum ALT, AST, ALP in cigarette smokers and controls.

Parameters	Controls	Cigarette Smokers
ALT (U/I)	**9.260 ± 0.570**	**18.430 ± 1.5*** **
AST (U/I)	**8.170 ± 0.336**	**16.225 ± 1.38*** **
ALP (U/I)	**30.735 ± 0.796**	**44.323 ± 1.937*** **

*** **p<0.001**

Table-2 shows comparison between the liver enzymes activity according to duration of smoking (5-10, 10-20 and more than 20 years) and control. for smokers ALT activities were (14.513 ± 1.355) $p<0.01$, (20.146 ± 1.240)$p<0.001$ and (20.837 ± 1.650)$p<0.001$ compared with control (9.260 ± 0,570 respectively. The smokers AST activities were (12.970 ±1.382), (17.0.87 ± 0.927) and (18.678±1.989) compared with control (8.170 ± 0.336) respectively. There was significant difference in AST activities $p<0.05$, $p<0.01$ and $p<0.001$ according to duration of smoking respectively.

While smokers ALP activities were (43.884 ±2.078), (44.530 ± 2.779) and (44.836 ± 1.807), $p<0.01$ compared with control (30.735 ± 0.796), respectively.

Table 2- Levels of the enzymes ALT, AST, ALP in the serum of smokers compared with control serum, according to the period of smoking . ** $P<0.01$, *** $P<0.001$.

Period of Smoking in (in years)	No. of subject	ALT(U/I)	AST (U/I)	ALP (U/I)
Controls	**40**	**9.260 ± 0.570**	**8.170 ± 0.336**	**30.735 ± 0.796**
5-10	**35**	**14.513 ± 1.355****	**12.970 ± 1.382****	**43.884 ± 2.078****
10-20	**34**	**20.146 ± 1.240*****	**17.087 ± 0.927*****	**44.530 ± 2.779****
>20	**31**	**20.837 ± 1.650*****	**18.678 ± 1.989*****	**44.836 ± 1.807**

Table-3 shows electrolytes (Na^+, K^+, Cl^-, Fe^{+2} and Po_4^{-3}) in serum of cigarette smokers and control groups, from the results observe no significant change in serum Na^+, K^+ and Cl^- levels, where as significant ($p<0.0001$)increase observe in level Fe^{+2} in cigarette smokers in compared to controls. While a significant decrease in Ca^{+2} compared to control and a significant ($p<0.05$) change in Po_4^{-3} concentration in cigarette smokers compare to control group.

Table 3- level of serum electrolytes in cigarette smokers and controls.

Parameters	Controls	Cigarette smokers
Potassium (mmol/l) (k^+)	**4.455 ± 0.080**	**4.400 ± 0.465**
Sodium (mmol/l) (Na^+)	**138.720 ± 0. 955**	**137.639 ± 0.322**
Iron (µg/dl) (Fe^{+2})	**23.410 ± 0.565**	**27.010 ± 0.737*****
Calcium (mg/dl) (Ca^{+2})	**9.045 ± 0.050**	**8.575 ± 0.029*****
Chloride (mmol/l) (Cl^-)	**98.560 ± 0.687**	**100.120 ± 0.394**
Phosphorus(mg/dl)(Po_4^{-3}	**4.024 ± 0.102**	**4.226 ± 0.038***

$^{*}P<0.05$, $^{***}P<0.001$

Table -4 shows a significant decrease in Na^+ ions level ($p<0.05$) compared to control in serum of smokers for more than 20 years, and decrease in K^+ ions but it is not significant decrease, while significant increase compared to control smoking period, and a significant decrease in Ca^{+2} level compared to control period of smoking.

Table 4-Levels of electrolytes in the serum of smokers and control according to the period of smoking.

Period of smoking (in years)	No. of subjects	Potassium (mmol/l) (k^+)	Sodium (mmol/l) (Na^+)	Iron (µg/dl) (Fe^{+2})	Calcium (mg/dl) (Ca^{+2})	Chloride (mmol/l) (Cl^-)	Phosphors (mg/dl) (Po_4^{-3})
Controls	**40**	**4.455±0.080**	**138.720±0.955**	**23.410±0.565**	**9.045±0.050**	**98.560±0.687**	**4.024±0.12**
5-10	**35**	**4.400±0.068**	**137.827±0.537**	**27.610±1.167*** **	**7.776±0.030*** **	**100.200±0.650**	**4.158±0.02**
10-20	**34**	**4.375±0.080**	**137.350±0.225**	**28.067±1.240*** **	**7.594±0.045*** **	**100.540±0.680**	**4.245±0.09**
>20	**31**	**4.321±0.082**	**136.643±0.425***	**28.400±1.480*** **	**7.586±0.053*** **	**101.825±0.675**	**4.270±0.00**

***P<0.05, ****P<0.001**

The results shows a significant increase in levels of activity of the liver enzymes ALT, AST and ALP in smokers compare to non-smokers and increase in proportion with duration of smoking. These results agreement with the levels of liver enzymes ALT, AST and ALP in which increased duo to exposure to smoke or duo to release high level of the cellular oxidative radicals as reported in [9-11].

The serum levels of ALT and AST were significantly affected by daily amount of smoking, but there are a multivariable affected is adjusted for gender, age, body mass index, daily current smoking and lifetime of smoking as reported in [12].

Several studies in concerning to osteoporotic changes documented have increase serum ALP levels in current smoking persons [13]. Cigarette smoking was associated with significant increase in level of ALP and inversely associated with increased AST, [14]. The some recent studies argued that the smoking does not cause damage to hepatocytes directly, because it is not effect on the ALT and AST activities as reported in [15].

Sodium with potassium assists to maintain the balance between the body electrolytes and water [16]. The some important role of Na^+ and K^+ are the nerve conduction and muscle contraction [17].

In this study there is no significant changes in serum Na^+, K^+ and Cl^- in cigarette smokers when compared to controls, and these agreement with what it's referred to Al-harbi who find that there is no significant differences in the concentration of Na^+, K^+ levels in the blood plasma of smokers compared to control, since people consume enough salt in diet [18].

The low concentration of Ca^{+2} level in the serum of the smokers in compare to control, duo to the cigarette smoke is related to the failure of the many mechanisms that regulate the electrolyte levels inside and outside the cells, as a result in response to the factor of smoking, will lead to loss of the large amounts of Ca^{+2} in the urine, or may be the smoking has an effect on the parathyroid gland, because the function of this gland is to regulate the level of the calcium in the serum. There for the smoking lead to reduction of the bone density and absorption of the Ca^{+2} and vitamin D_3 levels [19].

Cigarette smoking has large effects on the body and bone metabolism by causing decrease Ca^{+2} absorption, as well as low bone density [20].

Some explanations might be that the smokers have a low calcium intake and vitamin D_3, duo to some factors such as low Ca^{+2} absorption and high Ca^{+2} resorption from the skeleton or an excessive excretion of Ca^{+2} in the urine, this will lead to negative Ca^{+2} balance and normally will cause compensatory elevated in serum parathyroid hormone (PTH) [21].

Increase Po_4^{-3} levels in the smokers compared to controls, duo to complexes with calcium or disturbance in secretion of (PTH). These results was agreements with previous studies [15].

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