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Lipid, Liver Related and other Clinical Parameters affect Study of Cigarette Smoking Patient

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Abstract: Background and objective: Cigarette smoking is one of the 10 greatest contributors to global death and disease. Cigarette smoke consists of many chemicals, including cytotoxic, carcinogenic and free radicals, therefore it affects many organs if not all. This work is directed to evaluate the effects of dose response patterns of tobacco exposure on liver tissue, through assessing some serum biochemical parameters related to liver efficiency.

Methods: This study was done in Kirkuk province. It was conducted on (75) healthy male subjects, their ages ranged from 20 to 40 years. They were divided into three groups; 25 heavy smokers, 25 moderate smokers, and 25 non-smokers. Blood was withdrawn for estimation of serum liver function test, lipid profile, and protein electrophoresis.

Results: There were statistically significant elevations in serum alkaline phosphatase (ALP), alanine transaminase (SGPT) and aspartate aminotransferase (SGOT) activities in heavy smokers while serum total bilirubin significantly was lower compared to nonsmokers. Serum total protein and albumin were significantly lower in heavy smokers comparing to non-smokers. The results of serum protein arose gel-electrophoresis showed significant changes in serum protein fractions in smoker groups. The mean level of serum total cholesterol, triglyceride, LDL, and VLDL was significantly higher in heavy smoker group, while serum HDL level had a significantly lower value.

Conclusion: Cigarette smoking can affect liver efficiency and functions. These effects are dose exposure dependent.

Keywords: Cigarette Smoking, Liver Function Test, Liver Enzymes, Lipid Profile.

INTRODUCTION

Cigarette smoking is a major cause of preventable morbidity and mortality¹. Worldwide, more than 3 million people currently die each year from cigarette smoking². The risk of death in the smokers measured by the number of cigarettes smoked daily, the duration of smoking, the degree of inhalation and the age of initiation^{3,4}. Cigarette smoke contains over 4000 different chemicals, 400 of which are proven to be carcinogenic; it also contains various oxidants such as oxygen free radicals and volatile aldehydes which are probably the major causes of damage to biomolecules⁵. Cigarette smoking yields chemical substances with high cytotoxic potentials⁶. Cigarette smoke consists of many chemicals, including nicotine, tar with its many carcinogens, and gaseous compounds including carbon monoxide⁷.

Cigarette smoke also contains large numbers of free radicals that are capable of initiating or promoting oxidative injury⁸. Cigarette smokers are at greater risk for cardiovascular diseases, respiratory disorders, cancers, peptic ulcers and gastro esophageal reflux disease, blind-ness, bone matrix loss, and hepatotoxicity comparing with non-smokers⁹. Cigarette smoking causes a variety of adverse effects on organs that have no direct contact with the smoke itself such as the liver.

The liver is an important organ that has many tasks; such as responsibility for processing drugs, alcohol and other toxins to eliminate them from the body^{10, 11}. Till date, there is no previous study that concerned with the full investigation of the effect cigarette smoke and dose exposure to tobacco smoke (the number of cigarettes smoked per a day) on liver tissue and liver functions. The present study was constructed to evaluate the link between cigarette smoking and the biochemical state of the liver throughout investigating the effect of cigarette smoking on liver function test and lipid profile, and assessing the effect of cigarette smoking on other parameters such as protein, albumin and globulins, then studying the effect of cigarette smoking on protein electrophoresis.

Subjects

Total of (75) healthy subjects was enrolled in the present study during their attendance to outpatient department at Rajeev Gandhi College and General Hospital, Trilanga Bhopal (MP) Their ages were ranged from (20-45) years. Obese subjects (BMI> 29) and subjects who received medications were excluded. The subjects were classified according to the number of cigarettes smoked per day and the duration of smoking, into heavy smoker group (25 subjects), moderate smoker group (25 subjects), and non-smoker group (control group) (25 subjects).

Sample Collection

Five milliliters (5 ml) of blood was withdrawn from each subject. The blood was allowed to clot in a plain tube for 20 minutes at room temperature. The serum was separated by centrifugation at 3000 rpm for 10 minutes, then each subject serum was stored in five plain tubes (5 aliquots), frozen at -20 C until the day of the biochemical assay (except for the enzyme studies which were done directly).

Methods

1. Body mass index was calculated according to Martin and Crook method¹².
2. Liver function tests, including; serum ALP, ALT and AST, and (STB) were assed according to Kind and King Method¹³, Reitman and Frankel method¹⁴, and Walters and Gerarde method¹⁵, respectively.
3. Serum Protein (Gornall method)¹⁶, albumin (Douma's method)¹⁷, and globulin (from the equation of Clarke and Dufour¹⁸).
4. Agarose gel protein electrophoresis was performed¹⁹.
5. Lipid profile (Total cholesterol, Triglyceride, LDL, HDL, and VLDL)

Statistical Analysis

The computerized statistical analysis was performed using SPSS version 14 computer software. The level of statistical significance was (P< 0.05).

The results showed that serum ALP, ALT, and AST levels were significantly high (P value<0.05) in heavy smoker group when compared with non-smoker group, while serum STB was significantly low (P value>0.05), Table 1. No statistically significant differences (P value>0.05) were observed in ALP, AST, ALT and STB levels for moderate smoker group comparing with non-smoker group, Table 2.

Serum total protein, albumin, and globulin were significantly lower (P value<0.05) in both heavy and moderate smoker groups when compared with non-smoker group, while there were no important differences in serum albumin-globulin ratio (A/G) between smoker groups and non-smoker group, Table 3 and Table 4. The results showed that, there was no difference in the number of bands that appear on the protein gel-electrophoretic pattern, but there was a significant difference in the concentration of bands among the study groups, Figure1. The results showed that the mean of albumin, α -2 and γ globulins had lower values in heavy smoker group when compared with non-smoker group but the mean of α -1 and β globulins had higher levels. In moderate smoker group, the mean of albumin and α -2 globulin had a lower level when compared with non-smoker group and the mean of β globulin had higher values, while there was no difference in the mean of α -1 and γ globulins between moderate smoker and non-smoker groups, Table 7 and Table 8.

Table 5 shows that serum total cholesterol, triglyceride, LDL and VLDL levels were significantly higher in heavy smoker group (P<0.05) comparing with non-smoker group, while the value of serum HDL was significantly lower (P <0.05). In moderate smokers, the values of serum total cholesterol and LDL were significantly higher (P<0.05) than that of non-smokers, while serum HDL was significantly lower (P<0.05), Table 8. There was no significant difference (P>0.05) in serum triglyceride and VLDL levels between moderate smokers and non-smokers.

Table 1: Mean±SE of Serum ALP, AST, ALT, STB Levels for Heavy Smoker Group Compared with Non-smoker Group.

Parameters	Unit	Moderate Smoker		Non-smoker		P Value	
ALP	IU/L	39.0	±1.49	31.50	±1.62	0.0015	S
AST	IU/L	20.0	±0.74	16.2	±0.81	0.00135	S
ALT	IU/L	19.0	±0.73	15.3	±0.80	0.0017	S
STB	mg/dl	0.8	±0.01	0.9	±0.01	0.0002	S

Table 2: Mean±SE of Serum ALP, AST, ALT, STB Levels for Moderate Smoker Group Compared with Non-smoker Group.

Parameters	Unit	Moderate smoker		Non-smoker		P Value	
ALP	IU/L	35.8	±1.43	31.5	±1.62	0.0554	NS
AST	IU/L	14.2	±0.72	16.2	±0.81	0.536	NS
ALT	IU/L	15.1	±0.71	15.3	±0.80	0.736	NS
STB	mg/dl	0.9	±0.01	0.9	±0.01	0.4524	NS

Table 3: Mean±SE of Serum Total Protein, Albumin, Globulin and (A/G) Ratio for Heavy Smoker Group Compared with Non-smoker Group.

Parameters	Unit	Heavy Smoker		Non-smoker		P Value	
T PROTEIN	g/dl	6.4	±0.06	7.1	±0.06	0.00001	S
ALBUMIN	g/dl	4.1	±0.08	4.3	±0.09	0.0385	S
GLOBULIN	g/dl	2.4	±0.05	2.8	±0.1	0.0011	S
A/G		1.7	±0.05	1.6	±0.09	0.4487	NS

Table 4: Mean ± SE of Serum Total Protein, Albumin, Globulin and (A/G) ratio for Moderate Smoker Group Compared with Non-smokers.

Parameters	Unit	Moderate Smoker		Non-smoker		P Value	
T PROTEIN	g/dl	7.1	±0.05	7.1	±0.06	0.7985	NS
ALBUMIN	g/dl	4.5	±0.05	4.3	±0.09	0.1281	NS
GLOBULIN	g/dl	2.6	±0.03	2.8	±0.1	0.9474	NS
A/G		1.7	±0.03	1.6	±0.09	0.2751	NS

Table 5: The Mean ± SE of Serum Total Cholesterol, Triglyceride, LDL, VLDL and HDL Levels for Heavy Smoker Group Compared With Non-smoker Group

Parameters	Unit	Heavy Smoker		Non-smoker		P Value	
T cholesterol	mg/dl	178.24	±0.86	174.14	±1.15	0.000033	S
Triglyceride	mg/dl	178.57	±6.84	144.7	±7.17	0.0016	S

HDL	mg/dl	35.8	±1.43	41.45	±0.75	0.0006	S
VLDL	mg/dl	35.71	±1.37	28.94	±1.49	0.0016	S
LDL	mg/dl	115.7	±2.51	103.74	±2.03	0.000343	S

Table 6: Mean±SE of Serum total Cholesterol, Triglyceride, LDL, VLDL and HDL Levels for Moderate Smoker Group Compared with Non-smoker Group.

Parameters	Unit	Moderate Smoker		Non-smoker		P Value	
T cholesterol	mg/dl	178.62	±0.9	174.14	±1.15	0.00296	S
Triglyceride	mg/dl	164.34	±6.59	144.7	±7.17	0.05579	NS
HDL	mg/dl	36.64	±1.43	41.45	±0.75	0.003057	S
VLDL	mg/dl	32.87	±1.32	28.94	±1.49	0.05489	NS
LDL	mg/dl	115.21	±3.2	103.74	±2.03	0.00253	S

Table 7: The Percentage of Protein Fractions in Heavy, Moderate and Non-Smoker Groups on Agarose Gel-electrophoresis.

Group	Albumin	a-1	a-1	b	g
Heavy Smoker	65%	3.08%	8.64%	13.91%	9.08%
Moderate Smoker	70.29	2.08%	6.32%	10.89%	10.15%
Non-smoker	71.28	1.79%	10%	7.18%	9.24%

Table 8: The Concentrations of Protein Fractions in Heavy, Moderate and Non-smoker Groups on Agarose Gel-electrophoresis

Group	Total Protein	Albumin	a-1	a-1	b	g
Heavy Smoker	6.85	4.46	0.22	0.59	0.96	0.62
Moderate Smoker	6.8	4.77	0.15	0.44	0.75	0.69
Non-smoker	7.84	5.65	0.14	0.72	0.60	0.73



Figure 1: Serum Protein Electrophoretic Pattern for Heavy, Moderate and Non-smoker Groups

DISCUSSION

The results showed a significant rise in serum ALT, AST and ALP activity in cigarette smokers when compared to control group. This may occur due to nitrosative stress which is a condition that occurs when the production of highly reactive nitrogen-containing chemicals, such as nitrous oxide, exceeds the ability of the human body to neutralize and eliminate them. Nitrosative stress can lead to reactions that alter protein structure thus interfering with normal body functions^{20,21}. Cigarette smoke contains a large number of chemical substances with hepatotoxic potential including nicotine⁶. The results show that there was no statistically significant difference in serum ALT, AST, ALP and TB between moderate smoker group and control group. From the results of the present study, one can conclude that there is a dose response relationship between the number of cigarettes/day smoked and serum ALT, AST, ALP and total bilirubin levels. From the results, a statistically significant reduction in serum total protein, serum albumin and serum globulin in heavy smoker group were observed. The results also show that there were significant reductions in the serum total protein and serum albumin levels in moderate smoker group, while serum globulin levels didn't change. Cigarette smoking is associated with increased oxidative stress. Albumin has antioxidant properties, through binding to copper ions and scavenging HOCl, then the oxidized albumin may be cleared rapidly from the circulation and degraded^{22,23}. The present study revealed that se-rum protein electrophoretic pattern changed in both heavy and moderate smokers when compared with non-smoker group. To the best of our knowledge and on the basis of active literature searching, other researchers did not investigate the protein fractions by protein-electrophoresis in their studies. From the results, it can be suggested that cigarette smoke contains many potential hepatotoxic substances which affect liver function through its effect on serum protein electrophoresis fractions, this is due to its effect on their synthesis and metabolism in the liver. There is a great relationship between liver and lipid because all lipid profile parameters are synthesis and metabolized in liver 24, 25. The present study revealed that serum TG, TC, LDL, and VLDL was significantly higher in heavy smokers as compared to both moderate and non-smokers thereby revealing a direct dose response relationship. Serum HDL level was significantly lower in heavy smokers when compared to non-smokers.

Lipid alteration in cigarette smokers may be due to nicotine which stimulates the secretion of catecholamine's resulting in increasing the rate of lipolysis and the increased concentration of plasma free fatty acids (FFA) which further result in increasing the releasing of hepatic FFAs and hepatic triglycerides along with VLDL to the blood stream^{26,27}. The results of the present study showed that, serum TC and LDL levels were significantly higher in moderate smokers when compared with non-smokers. From the results of this work, one can emphasize that lipid profile is affected by the dose response of tobacco exposure. Finally cigarette smoke also induces oxidative stress by stimulating NADPH oxidase and decreasing antioxidant defenses, leading to lipid peroxidation²⁸. These effects could lead to increased hepatocellular damage²⁹.

CONCLUSION

Cigarette smoking can affect liver functions, through its effect on serum ALP, ALT and AST total protein, albumin, globulin, protein fractions in gel-electrophoresis pattern. It also affects lipid profile. Focused specifically on the effect that smoking cigarettes have on the liver damage caused by a common chronic liver disease.

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