Medicine

A COMPARATIVE STUDY OF LIPID PROFILE AMONG SMOKERS AND NON-SMOKERS

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ABSTRACT

CONTEXT : Smoking is considered a major risk factor for the development of ischemic heart disease. This may be partly due to the plasma lipoprotein abnormalities leading to atherosclerotic vascular disease.

AIM OF THE STUDY: This study is done to compare lipid profile among smokers and nonsmokers and to study variable patterns of lipid profile in terms of intensity of smoking.

STUDY DESIGN : Cross sectional study

MATERIALS AND METHODS: This study was conducted among 200 male patients who attended Government Rajaji hospital, Madurai, outpatient department. 100 of these were nonsmokers, 100 were smokers. smokers. Smokers were further grouped into into mild, moderate and severe smokers depending on the numer of cigarettes used per day. Fasting lipid profile was done for all.

STATISTICAL ANALYSIS : Students 't'test and Man Whitney test.

RESULTS: Increase in total cholesterol, triglycerides, LDL and VLDL were found in smokers of all age groups, whereas HDL showed an inverse relationship. A direct relationship exists between the severity of smoking and increase in the total cholesterol, triglycerides, LDL and VLDL while an inverse relationship is found with HDL.

CONCLUSION: Asymptomatic smokers are at the risk of developing coronary artery disease. Tobacco smoking is associated with dyslipidaemia (Increase LDL-C and decrease HDL-C levels), which is atherogenic in nature.

KEYWORDS :

Introduction

Tobacco is one of the most potent and prevalent addictive, influencing behavior of human beings for over four centuries. Cigarette smoking is the most common type of tobacco use. Tobacco continues to be the second major cause of death in the world. Smoking is an important risk factor for atherosclerosis, peripheral vascular disease and stroke and cancers. Cigarette smoking leads to the uptake of many hazardous compounds and their metabolites extracted from burning tobacco. The substances may be electrophilic and react with biological molecules giving rise to oxidative stress through the formation of reactive species or the initiation of lipid peroxidation chains in the membranes.

Cigarette smoking has been found to alter the lipoprotein levels. A one to three fold increase in risk of myocardial infarction has generally been noted among smokers. Most of the studies indicate definite correlation between smoking and lipid profile alteration in which there is definite dose response relationship between the number of cigarette smoking as well as the duration of smoking and changes in the lipid profile noted.

In spite of all these information, there is much controversy about which part or parts in the lipid profile are mainly altered in response to cigarette smoking. In the present study, an attempt has been made to find out the effect of smoking on the lipid in the health smokers are compared with that of same age group healthy non-smokers.

Materials and methods

This study was conducted among 200 patients who attended Government Rajaji hospital, Madurai, outpatient department for various ailments from July 2014 to September 2014.

Inclusion Criteria

(1) Age: 20-50 years. (2) 100 males who never smoked. (3) 100 males smoking for >= 5 years, divided into three groups depending on intensity of smoking: (a) Mild Smokers (1 – 10 Cigarettes / Bidis per day) (b) Moderate Smokers (11 – 20 Cigarettes / Bidis per day) (c) Severe Smokers (> 20 Cigarettes / Bidis per day)

Exclusion Criteria

(1) Obese. (2) Those on diet restriction. (3) Drugs that alter lipid profile. (4) Alcoholism (5) Diseases that alter lipid profile like diabetes mellitus, hypothyroidism, and renal failure. (6) Hypertension and coronary artery disease.(7) Family history of dyslipidemia.

Subjects were explained in detail about the study and written informed consent was taken. Prior approval of Institute's Ethical Committee was taken. The blood samples for analysis were taken after a minimum of 12 hours of complete fasting. A fat free diet was advised on the day prior to sampling. Serum was separated within 2 hours of collection and samples were analyzed the same day or within 48 hours. Lipid and lipoprotein assay was done using the Dr. Lange LP 700 equipment.

Serum cholesterol, TG and HDL cholesterol was measured by the equipment. LDL – cholesterol was calculated by using a standard WHO approved formula based on the total cholesterol, triglyceride and HDL – cholesterol values.

$$LDL\ cholesterol = Total\ cholesterol - (HDL + TG/5)$$

TG/5 indicates the cholesterol in VLDL fraction and was used when the TG levels were below 400 mg/dI.

Statistical analysis

Mean levels of various variables were correlated with basal reference for normal individuals. Relevant statistical methods like student 't' test and whenever required Mann-Whitney test was used to see the significance of difference in mean values between groups and to know there correlation between inter and intra group variation.

Results and discussion

Table 1. Comparison of Lipid Profile among Smokers and Non Smokers.

	Age(yrs)	No.	Non-smokers	No.	Smokers
TC	21-30	36	156.64±22.58	30	197.17±32.59
	31-40	43	163.84±29.21	49	191.45±29.72
	41-50	21	163.52±27.11	21	185.71±32.08
TG	21-30	36	101.75±21.51	30	171.33±29.16
	31-40	43	103.65±29.53	49	163.08±25.88
	41-50	21	106.57±26.3	21	157.05±32.97
HDL	21-30	36	50.47±7.84	30	42.47±10.68
	31-40	43	48.88±9.34	49	44.98±8.96
	41-50	21	49.48±7.96	21	47.33±10.38
LDL	21-30	36	80.44±16.55	30	107.23±19.95
	31-40	43	83.84±15.67	49	103.18±18.59
	41-50	21	82.52±17.99	21	96.9±14.88
VLDL	21-30	36	20.44±6.2	30	30.7±10.12
	31-40	43	23.21±6.39	49	28.73±8.56
	41-50	21	20.71±6.21	21	27.29±7.73

HDL/TC	21-30	36	0.33±0.1	30	0.23±0.09
	31-40	43	0.32±0.11	49	0.25±0.08
	41-50	21	0.32±0.08	21	0.27±0.1

NB: Lipid parameters in mg/dL.

Table 2. Comparison of Lipid Profile among Non-Smokers and Smokers (with respect to intensity of smoking)

	Intensity	Non-smokers	Smokers	P value
TC	Mild	161.18±26.77	183.06±67	<0.05
	Moderate	161.18±26.77	194.09±29.39	<0.001
	Severe	161.18±26.77	209±29.15	<0.001
TG	Mild	103.58±26.26	155.06±68	<0.001
	Moderate	103.58±26.26	166±26.63	<0.001
	Severe	103.58±26.26	176.5±25.62	<0.001
HDL	Mild	49.58±8.57	48.03±8.79	<0.5
	Moderate	49.58±8.57	45.06±10.26	<0.07
	Severe	49.58±8.57	42±9.67	<0.05
LDL	Mild	82.34±16.57	97.12±13.26	<0.001
	Moderate	82.34±16.57	105.58±20.07	<0.001
	Severe	82.34±16.57	114±20.41	<0.001
VLDL	Mild	21.69±6.42	23.15±7.65	<0.001
	Moderate	21.69±6.42	32.73±6.67	<0.001
	Severe	21.69±6.42	34±9.27	<0.001

The present study was carried out among 200 patients who attended Madurai Rajaji Government Hospital. 100 smokers and 100 non-smokers were selected for this study. The study was conducted from July 2014 to September 2014.

All the patients studied were males. The population was selected in the age group of 20 to 50 years. Among non-smokers the mean value of total cholesterol was 161.18±26.77, triglycerides was 103.58±26.26, HDL was 49.58±8.57, LDL was 82.34±16.57 and VLDL was 21.69±6.42.

Among mild smokers the mean value of total cholesterol was 183.06±33.38, TG was 155.06±31.80, HDL was 48.03±8.65, LDL was 97.12±13.05 and VLDL was 23.15±7.67. Among moderate smokers the mean value of total cholesterol was 194.09±29.39, triglyceride was166±26.63, HDL was 45.06±10.26, LDL was 105.58±20.07 and VLDL was 32.73±6.67. Among severe smokers the mean value of total cholesterol was 209±29.15, triglycerides was 176.50±25.62, HDL was42±9.67, LDL was 114±20.41 and VLDL was 34±9.27.

Total Cholesterol:
In the age group of 21 to 30 (30 persons) the mean total cholesterol value was 197.17 in smokers, while in non-smokers it was 156.64 (36 persons). In smokers of age group 31 to 40 (49 persons) the mean total cholesterol was 191.45 while in non-smokers it was 163.84(43 persons). The mean total cholesterol was 185.71 in smokers (21 persons) of age group 41 to 50 years while it was 163.52 in non-smokers (21 persons). The association of an increased total cholesterol value with smoking was noticed when smokers were compared with non-smokers of the similar age group. The mean total cholesterol value was 191.96 in smokers (100 persons) and 161.18 in non-smokers (100 persons), P value <0.001.

Karvonen et al also has noted such a correlation between smoking and elevation of cholesterol. This study is also in accordance with study done by R.K. Tilwani, B. sapra, P.K.Sharma, R.K.Goyal in .L.N.Medical College and A.G.Hospital, Ajmar.

HDL Cholesterol:
Of the smokers in 21-30 years of age group the mean value of HDL cholesterol stood 42.27mg/dl while the non-smokers showed a mean value of 50.47. Age related decrease was observed in the advancing age group probably due to increase in the duration of smoking. Smokers in the age group 31-40 years had mean HDL value of 44.98 mg/dl (49 persons), which is low compared to non-smokers of the same age group 48.88mg/dl (43 persons). In the age group of 41-50 years the smokers had a mean HDL value of 47.33mg/dl (21 persons) while the non-smokers of the same age group had a mean HDL value of 49.48 (21 persons). The mean HDL in smokers was 44.72 mg/dl (100 persons) while the mean of non-smokers was 49.58 mg/dl (100 persons). P value =0.002.

Chemical pathology and medicine department of St. Marys hospital, London conducted a study and put forward an explanation to this effect. The action of endothelial lipoprotein lipase on triglyceride rich lipoprotein reduces the core volume of these particles and generates surface remnants containing unesterified cholesterol, phospholipid and apoprotein, which join the HDL3 pool. These surface remnants are thought to constitute the major source of HDL precursors and lipoprotein lipase is thought to be a major determinant of plasma concentration of HDL. Esterification of the acquired free cholesterol in HDL3 particles by lecithin cholesterol acyltransferase results in the accumulation of cholesterol ester in the core of the particles and the production of larger, less dense HDL2 particles. A transfer protein mediates the exchange of cholesterol ester in HDL with triglyceride in lipoprotein of a lower density. The magnitude of postprandial lipaemia determines the extent of this exchange and resultant triglyceride content of HDL2 particles.

TG rich HDL2 particles are converted to HDL3 particles by removal of the TG from the core of the particles, whereas phospholipid is removed from the surface of TG poor HDL2 particles without any change in size or density. Reduced intravascular lipolysis exists in smokers, hence it was suggested that a consequent increase in the postprandial lipaemia in smokers will result in a greater proportion being converted to HDL3 particles by hepatic lipase. This would explain the lowering of HDL2 and the increase in the concentration of HDL3 cholesterol found in smokers. HDL2 concentration correlates negatively with the severity of angiographically defined atheroma. The change in HDL that is reported in young smokers and the increased exposure of vascular endothelium to the potentially atherogenic lipoproteins as a consequence of impaired clearance of TG rich lipoproteins is the mechanism whereby smoking predisposes to coronary artery disease.

Present study had not focused on HDL values following cessation of smoking. But data published by Moffatt R.J. et al and Quensel et al revealed normalization of HDL in smokers who gave up that habit. Present results are in concordance with R.K. Tilwani et al study in J.L.N. Medical College and A.G. Hospital, Ajmer and also with study done by R.Rastogi and others in L.L.R.M. Medical College .

LDL-Cholesterol:
Quantitative estimation of LDL in this study showed a mean value of 107.23mg/dl in smokers of 21-30 years age group which comprised 30 participants while the non-smokers (36 persons) showed a value of 80.44mg/dl. Mean LDL values of smokers in the age group 31-40 (49 persons) was 103.18mg/dl and that of non-smokers of the same age group (43 persons) was 83.84mg/dl. Mean LDL values of smokers of the age group 41-50 was 96.9mg/dl and that of non-smokers was 82.52mg/dl. The LDL values were high in the smokers compared with non-smokers of the same age group. The mean LDL value in smokers was 103.08mg/dl when compared with non-smokers which was 82.34mg/dl. P-value (<0.001). To establish a causal relationship between exposure to cigarette smoke and changes in serum lipid and lipoprotein concentrations, dose response effects were calculated by an analysis of 54 published studies conducted by Wendy Y.F. and his associates from the foundation of Blood research, Scarborough, USA. They found a higher mean concentration of cholesterol (3%), triglycerides (9.1%), VLDL (10.4%), LDL (1.7%). The dose response effect on VLDL and LDL among non-smokers, mild, moderate and severe smokers were (0, 7.2, 44.4, 39.0%) and (0, -1.1, 1.4, and 11.0%) respectively. This study results are comparable with LDL levels of R. Rastogi and other's study on the same topic. R. Rastogi et al study showed higher levels of LDL in heavy smokers.

Triglycerides:
In the age group of 21-30 years smokers (30 persons) showed a mean value of 171.33 mg/dl while the mean value of triglyceride in non-smokers was 101.75mg/dl in the same age group. In the 31-40 years age group mean value among smokers was 163.08mg/dl (49 persons): non-smokers showed 103.65mg/dl (43 persons). The mean triglyceride value was 157.05mg/dl in smokers of age group 41-50 years (21 persons) and in non-smokers it was 106.57mg/dl (21 persons). The mean value of TG in smokers was 164.29mg/dl when compared to non-smokers, which was 103.58mg/dl. (P value <0.001). The triglycerides show a steady increase with increase in the severity of smoking. The Craig WY study on persons in 8-19 age groups had shown an increase of 11.8% in smokers for the triglyceride value while their analysis of the 54 published data showed an increase in triglyceride value of 9.1% in smokers compared to non-smokers.

Sympatho-adrenal system stimulation by nicotine leads to lipolysis and increased serum free fatty acid levels which lead to increased synthesis of VLDL from the liver and hence triglycerides. These findings are also similar to those done by R.K. Tilwani (J.L.N. Medical College) and R. Rastogi L.L.R.M. Medical College. A.K. Sinha et al showed significant increase of LDL cholesterol in severe smokers.

HDL - Total Cholesterol Ratio:
Present study showed significant reduction in the HDL-C/TC ratio in smokers compared to non-smokers. The values in nonsmokers of age group 21-30, 31-40, 41-50 were 0.33±0.1, 0.32±0.11, and 0.32±0.08, while in smokers of the same age group the values were 0.23±0.09, 0.25±0.08, 0.27±0.1 respectively which was significantly low. This is also in accordance with studies conducted abroad and in India. A Comparative study of HDL-c/TC ratio showed in 0.25 in smokers when compared to 0.32 in non-smokers.

VLDL:
VLDL values of smokers of the age group 21-30, 31-40,41-50 years were 30.7, 28.73, 27.29 mg/dl respectively. While the values in nonsmokers of the similar age group were 20.44, 23.21, 20.71mg/dl respectively. Mean value in nonsmokers was 21.69 mg/dl while that of smokers was 29.02 mg/dl . P value (<0.001). VLDL values show a steady increase with the severity of smoking.

Comparison of values depending on the severity of smoking:
Mean total cholesterol in mild smokers was 183.06±33.38 while that of moderate smokers was 194.09±29.39, and that of severe smokers was 209±29.15. Cholesterol values were found to increase with increase in the severity of smoking. Mean triglyceride value of mild smokers was 155.06±31.80, while that of moderate and severe smokers were 166±26.63 and 176.5±25.62 respectively. With the increase in the severity of smoking there is increase in the triglyceride values. Mean HDL values of mild, moderate and severe smokers were 48.03±8.65, 45.06±10.26 and 42±9.67 respectively. HDL values show a steady decline with increase in the severity of smoking. Mean LDL values in mild, moderate and severe smokers were 97.12±13.05, 105.58±20.07, and 114±20.41 respectively. Values of LDL show a steady increase with increase in severity of smoking. Mean VLDL of mild, moderate and severe smokers were 23.15±7.67, 32.73±6.67 and 34±9.27 respectively which show an increase in values with increased severity of smoking. Mean total cholesterol value of non-smokers was 161.18±26.77 while that of smokers was 191.96±31.37. Mean triglyceride value of non-smokers was 103.58±26.26 while in smokers it was 164.29±28.95. Mean HDL value of non-smokers was 49.58±8.57 while in smokers it was44.72±9.96. Mean LDL values of non-smokers was 82.34±16.57 while in smokers it was 103.08±18.66. Mean VLDL value of non-smokers was 21.69±6.42 while in smokers it was 29.02±8.98. Total cholesterol, triglyceride, LDL and VLDL values were significantly elevated in smokers when compared to the non-smokers. HDL values were significantly lower in smokers when compared to the non-smokers. When HDL-C/TC ratio of smokers were 0.25 compared with that of non-smokers which was 0.32, significantly lower levels were found in moderate and severe smokers.

Figure 1. Comparison of Lipid Profile among Non-Smokers and Smokers (with respect to intensity of smoking)
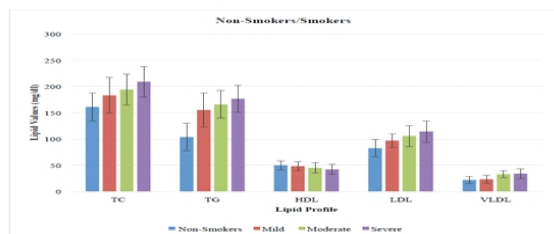
Conclusion
• Increase in total cholesterol, triglycerides, low-density lipoproteins and very low-density lipoproteins were found in smokers of all age group, whereas high-density lipoproteins showed an inverse relationship.
• A direct relationship exists between the severity of smoking and increase in the total cholesterol, triglycerides, LDL and VLDL while an inverse relationship is found with HDL.
• Asymptomatic smokers are at the risk of developing coronary artery disease due to the above changes in lipid profile.
• The observed values were in concordance with the studies done in India and other countries.

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