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Original Article

Biochemistry Section

Effect of Cigarette Smoking on Blood Levels of Lipid and Atherogenic Lipid Ratios

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ABSTRACT

Introduction: Lipid profile changes are a major risk factor for the cardiovascular diseases with the increase in sedentary life style and smoking. Smoking may lead to alter the normal plasma lipoprotein pattern.

Aim: To evaluate the lipid profile and atherogenic lipid ratios in the cigarette smokers.

Materials and Methods: The present study was conducted on 480 healthy male individuals of which (n=340) were cigarette smokers and compared with the healthy age matched non-obese non-smokers as controls (n=140). The lipid profile test was performed using the automated analyser and the atherogenic lipid ratios were calculated on excel. Statistical analysis was done using t-test on sophisticated tool.

Results: Study shows that there was significantly increased levels of total cholesterol, Low Density Lipoprotein Cholesterol (LDL-C), Triglyceride (TG), Very Low Density Lipoprotein (VLDL) in smokers and significantly lower levels of High Density Lipoprotein Cholesterol (HDL-C). The atherogenic ratios were statistically highly significant among the cigarette smokers compared to the non-smokers, showing the risk of the cardiac events higher among the smokers.

Conclusion: Smokers had impaired lipid profile and higher atherogenic lipid ratios. This knowledge can be used to identify the increased risk of cardiovascular disease in clinical practice in patients with history of smoking. These finding add another health enhancing benefits for the smokers by cessation and educating them about ill events.

Keywords: Cardiovascular disease, High density lipoprotein, Lipid profile, Low density lipoprotein, Serum total cholesterol, Triglyceride

INTRODUCTION

Smoking is the most common type of tobacco used and is common among the men aged 15 and above accounting for 51%. Globally, about 18% of adolescent boys use tobacco (GHO, WHO). Smoking is one among the most important risk factor for developing Chronic Obstructive Pulmonary Disease (COPD) [1]. In India, an estimated 82.3% males with COPD are smokers [2]. In India, according to Global adult tobacco survey last measured prevalence of tobacco smoking was 19% in men and 2% in women (2016-2017). By 2030, if current trend continue, smoking is expected to kill more than 9 million people annually [3].

The National Institute for Health and Care Excellence (NICE) 2010 guidance on cardiovascular disease identifies smoking as a significant contributing factor and argues that any intervention to reduce the risk should include referrals for smoking cessation [4].

Moreover, half of the decline in coronary heart disease mortality is seen after cessation of cigarette smoking. Smoking cigarettes could even encourage atherosclerosis partly because of its effect on lipid profile. Smokers have significantly higher levels of serum cholesterol, TG, and LDL, but lower levels of HDL in smokers than those of non-smokers. Studies are not clear about the mechanism, and the dietary variations between smokers and non-smokers are unclear [5]. Smoking cigarettes also increases oxidative modification of the LDL, Circulating lipid peroxidation products that are used as a proxy for oxidative stress in smokers. Abnormalities in plasma lipoprotein are said to be the underlying major risk factors and can even be important for the common occurrence of atherosclerotic vascular diseases [6]. This study was aimed to measure and compare the serum lipid profile, calculated atherogenic lipid ratios among tobacco smokers and non-smoker.

MATERIALS AND METHODS

This observational analytical study included healthy male adults attending for health check-up at OPDs between January to July 2018 at Tertiary Care Medical College Hospital, Mangalore, Karnataka, India. The ethics clearance was received before study participants were recruited (FMMC/FMIEC/4507/2017 Dated 12-12-2017).

A total of 480 male subjects (due to lower incidence of the female smokers at the study place) were included randomly who met the inclusion criteria aged between 18-60 years, of which, 340 healthy individuals who were smokers as cases and 140 non-smokers as control after obtaining the informed consent. The sample size was calculated using the online sample size calculator for the study with power of >80% with significance p-value <.05.

Inclusion Criteria: Males with smoking history (aged 18-60 yr) of more than a year and more than 10 cigarettes a day. Healthy controls who were non-smokers (aged 18-60 yr).

Exclusion Criteria: Occasional smoking, carcinomas, hypertension, respiratory tuberculosis, diabetes mellitus, chronic renal failure, liver diseases, tobacco chewer.

The Lipid profile tests include; Total cholesterol (Cholesterol oxidase/peroxidase) [7], HDL-C (Direct method polymers/detergent) [8], LDL-C (direct enzymatic, PEG modified) [9], Triglycerides (glycerol phosphate) [10], VLDL (TG/5) [11] was analysed on the Roche Cobas 6000 analyser at the clinical biochemistry laboratory. The other patient details were accessed from Hospital Information System (HIS). The Atherogenic lipid indices included are calculated as follows:

- Castelli's risk Index-I (CRI) = TC/HDL-C [12]
- Castelli's risk Index-II (CRII) = LDL-C/HDL-C [12]
- Atherogenic Index of Plasma (AIP) = Log TG/HDL-C [13]
- Atherogenic Coefficient (AC) = (TC-HDL-C)/HDL-C [14]
- Cholindex (CI) = LDL-C - HDL-C [15]

STATISTICAL ANALYSIS

The descriptive data was given as Mean, Standard Deviation, confidence interval, comparison of mean by t-test. The data was entered on Microsoft excel and analysis done on sophisticated statistical software SPSS version 23 (institutional licensed). The references were managed using the Mendeley software (version 1.17.11).

RESULTS

Total of 480 subjects were included in the study, divided as two groups: cigarette smoker's n=340 (cases) and non-smokers n=140 (controls). There was no significant difference between the mean values of age.

The mean difference of serum lipid levels in smokers and non-smokers which was highly significant, with the high level of serum cholesterol among smokers compared to non-smokers. The serum HDL, LDL, TG was significantly different among smokers and non-smokers [Table/Fig-1].

	Smokers (Mean±SD, n=340)	Non-Smokers (Mean±SD, n=140)	p-value
Age (Years)	46.1±11.0	45.38±12.0	NS
Cholesterol total (mg/dL)	225.15±36.6	189.35±32.8	0.001** HS
LDL-C (mg/dL)	149.5±25.7	127.0±28.9	0.001** HS
HDL-C (mg/dL)	39.6±9.5	45.26±9.3	0.001** HS
TG (mg/dL)	195.37±92.3	146.2±43.1	0.001** HS
VLDL-C (mg/dL)	38.6±18.6	29.14±11.5	0.001** HS

[Table/Fig-1]: Showing t-test result of serum lipid profile in cigarette smokers and non-smokers.
Demonstrating the mean difference between the two groups using t-test, *p-value <0.05, **p-value <0.001 HS (highly significant). LDL-C: Low density lipoprotein cholesterol, HDL-C: High density lipoprotein cholesterol; TG:Triglyceride, VLDL: Very low density lipoprotein cholesterol; NS-Not significant

There was statistical significant higher atherogenic lipid ratios among the cigarette smokers compared to non-smokers. Among smokers, CRI, CRII,AIP, AC, CI were significantly higher compared to non-smokers [Table/Fig-2].

	Smokers (Mean±SD, n=340)	Non-Smokers (Mean±SD, n=140)	p-value
CR-I	5.96±1.5	4.4±1.3	0.001** HS
CR-II	3.96±1.0	2.9±1.0	0.001** HS
AIP	0.66±.19	0.50±.18	0.001** HS
AC	4.96±1.5	3.40±1.3	0.001** HS
CI	109.95±25.9	81.73±32.4	0.001** HS

[Table/Fig-2]: Showing the mean difference of atherogenic lipid ratios in smokers and non-smokers.
Demonstrating the mean difference between the two groups using t-test; *p-value <0.05, **p-value <0.001 HS (highly significant). CRI: Castelli's risk index I; CRII: Castelli's risk index II, AIP: Atherogenic index of plasma; AC: Atherogenic coefficient; CI: Cholindex

DISCUSSION

The study was done to evaluate the lipid profile alteration in the smokers and to assess the atherogenic risk of lipid ratios in them. In present study authors have compared the lipid profile among smokers and non-smokers. The Total cholesterol, LDL-C, TG, VLDL had shown significantly higher levels in smokers. The so called Good cholesterol, HDL-C was significantly lower in smokers than the non-smokers. These changes showing the dyslipidemia in the case of apparently healthy cigarette smokers, the high level of LDL-C, VLDL, TG, Cholesterol were strongly associated with development of coronary artery disease while a lower levels of HDL-C remains as significant independent predictor of coronary artery disease [16,17]. Framingham study has demonstrated, within a given level of LDL-C, the risk of CHD depends on the levels of TGs and HDL-C [12]. Increased cholesterol levels and CHD are observed in cigarette smokers [18]. Hulley S et al., demonstrated the lower levels of HDL-C in smokers as the result of threat of development of the atherosclerosis and CHD is increased and direct relation of smoking with CHD been mentioned in MRFIT, who demonstrated that the increase levels in HDL-C by 1mg/dL was associated with decrease in risk of CHD by 3% [19]. [Table/Fig-3] demonstrates the significance of lipoproteins and atherogenic index among various studies [20-22].

Author	Sample size	Purpose	Conclusion
Zhu X et al., [20] 2018	6465 participants	Association of the AIP of plasma with smoking and obesity.	AIP was positively and strongly correlated with the history of smoking and obese compared to the healthy non-smokers and non-obese.
Zhen Li et al., [21] 2018	2523 patients	Relationship of the chronic microvascular complications and AIP in Type 2 diabetes	AIP represents a clinically convenient indicator to detect the high risk patients and complications of vascular events.
Gepner AD et al., [22] 2011	1504 participants	Study was designed to determine the effect of smoking cessation on the lipoproteins and was a Randomised clinical trial	Smoking cessation improved the HDL-C, total HDL and large HDL particles. However, did not affect the LDL or LDL Size. Improved HDL may mediate the reduced CVS risk.
Present study	480 participants	To measure and compare the serum lipid profile, calculated atherogenic lipid ratios among tobacco smokers and non-smoker	Significant difference in atherogenic lipoproteins and the calculated atherogenic ratios among smokers and non-smokers.

[Table/Fig-3]: Comparison of previous studies indicating the significance of lipoproteins and atherogenic index.

Gepner AD et al., conducted a randomised clinical trial to assess the effect to smoking and cessation in the smokers. They demonstrated that smoking cessation improved HDL-C, total HDL and large HDL particles; however cessation did not affect the LDL or LDL size [22]. Smoking causes alteration in lipid profile and increased duration and number of cigarette cause more dyslipidemia. This is related to increased risk for coronary disease [23]. The established atherogenic indices like CRI, AIP, AC, CI are all significantly higher in smokers than the non-smokers, clearly showing the increased risk of the cardiac events among the smokers than the non-smokers. Luz PL da et al., explained the ratio of TGs to HDL-C was found to be a powerful independent indicator of extensive coronary diseases among the smokers [24]. Some researchers suggest that, AIP is a highly sensitive marker of difference of lipoprotein in patients. AIP levels of -0.3-0.1 associated with low, 0.1-0.24 with medium and anything above 0.24 is considered to have high cardiovascular risk [25]. AIP levels in smokers group showed significantly higher which was in correlation with the study done by Ranjit MP et al., [26]. These atherogenic lipid ratios are helpful to assess and identify the risk of getting the Cardiovascular diseases among the cigarette smokers.

Limitation(s)

The study was conducted as a cross-sectional study, the long term follow-up of patients needs to be conducted. The study can also include the influence of non-smoking tobacco effect on these atherogenic ratios.

CONCLUSION(S)

Smokers have the alteration in their lipid profile with reduction in HDL-C and increase in other lipoproteins further promoting the atherogenic events. Hence, these atherogenic indices serve as a tools/test that can be used to identify individuals with risk of bad events in future due to atherogenesis. Help to educate and to promote for cessation of cigarette smoking for betterment of their health and their dependents.

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