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Original Research Article

Lipid profile and Atherogenic index of plasma (AIP) in diabetic non smokers and smokers in coastal Karnataka

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Abstract

Smoking is proven to be an independent risk factor for development of atherosclerosis and amongst diabetics it increases the risk of cardiovascular complications and stroke. Smoking is associated with increase in the serum concentrations of total cholesterol and very low-density lipoprotein cholesterol, and a decrease in serum high-density-lipoprotein cholesterol concentrations. Atherogenic index of plasma (AIP) is found to be useful marker in patients with diabetes as it increases the risk of cardiovascular disease. Present study was done to compare the lipid profile and AIP in diabetic non-smokers and diabetic smokers. There was significant increase in total cholesterol ($p<0.01$), triglycerides ($p<0.01$), TC/HC ratio ($p<0.001$) and AIP ($p<0.001$) and significant decrease in HDL ($p<0.05$) in diabetic patients who are smokers compared to diabetic patients who are non-smokers. According to the study, AIP could be used as a simple parameter to early assessment of risk for development of atherosclerosis in diabetic smokers.

Keywords: Atherosclerosis; Atherogenic index of plasma; Cardiovascular disease; Diabetes mellitus; Hyperlipidemia

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1. Introduction

Diabetes mellitus (DM) is a multi systemic metabolic disorder, showing common underlying features of hyperglycaemia, hyperlipidemia and vascular complications.[1,2] Hyperlipidemia in diabetes mellitus is hallmarked by low plasma HDL-C and high LDL-C and triacylglycerol levels, is common in patients with diabetes mellitus. These lipoprotein abnormalities are held to be responsible for considerable cardiovascular disease-related morbidity and mortality.[3] High serum triglyceride levels are associated with the risk of developing cardiovascular disease independently of other major measured risk factors.[4]

Smoking is proven to be an independent risk factor for the development of atherosclerosis. Several studies have shown that nicotine in the smoke acts on the cholinergic receptors in the brain and autonomic ganglia. The binding of nicotine to these receptors, opens the ion channel, allowing the entry of sodium and calcium, which in turn, augment the release of neurotransmitters.[5] The release of catecholamine and other neurotransmitters will increase the lipolysis and delivery of free fatty acids into the liver. In the liver free fatty acids undergo re esterification which in turn increases the concentration of VLDL. In diabetics, nicotine also produces insulin resistance which further enhances hyperglycaemia and its effects like atherosclerosis and coronary artery disease.[6]

Atherogenic index of plasma (AIP= log TG/HDL mmol/l) predicts the risk of development of atherosclerosis in diabetic patients as it considers the elevated levels of triglyceride as an important risk factor.[7] Recent studies have shown that serum triglyceride level is an independent determinant of cardiovascular risk across a broad population group with abdominal obesity.[8] The association of TGs and HDL-C in this simple ratio theoretically reflects the balance between risk and protective lipoprotein forces, and both TGs and HDL-C are widely measured and available.[9]

Present study was done to determine and compare the levels of fasting plasma glucose, fasting lipid profile, TC / HDL- C and AIP in diabetic non-smokers and diabetic smokers. To correlate the AIP with fasting plasma sugar (FPS) and lipid profile parameters.

2. Materials and methods

The study was carried out on total 72 patients and they were grouped into, group I consisting of 36 diabetic patients (mean age of 52 years) who are non smokers and group II consists of 36 diabetic patients (mean age of 53 years) who are smokers. Patients involved in the study were recruited from Kasturba Medical College Hospital, Mangalore, India, with average history of diabetes mellitus from last 5-6 years. All of them are smokers with mean duration of smoking for about 16 years. Patients with history of alcoholism were excluded from the study. Subjects included in the study were having average 15 beedies/cigarettes per day. Informed consent was taken from all subjects involved in the study and was approved by the aforementioned institutional ethics committee. Fasting blood samples were also collected from group I and group II patients and serum was separated subsequently and processed for determination of fasting lipid profile and fasting plasma glucose.

Fasting lipid profile (TC, TG, HDLc) and Fasting plasma glucose was estimated by enzymatic method using automated analyzer Hitachi 917. FPG was determined by modified glucose oxidase/peroxidase method.[10] Total cholesterol estimation was done by cholesterol oxidase method; high density lipoprotein was estimated by same method after precipitating the low density lipoproteins, very low density lipoprotein and chylomicrons.[11] Triglycerides were estimated by enzymatic mixture containing lipoprotein lipase, glycerol kinase and glycerol-3-phosphate oxidase and peroxidise.[12] LDL was calculated by Friedewald's formula (LDL=TC □ [HDL + TG/5]), TC/HDLc was calculated by dividing total cholesterol by HDL cholesterol.[13] AIP was calculated using formula, log TG /HDL, with TG and HDL expressed in molar concentrations. To convert mg/dl to mmol/L, divide the HDL cholesterol by 39 and triglyceride by 89.[14]

The results were expressed as mean ± standard error of mean (SEM). A $p<0.05$ was considered statistically significant. Statistical analysis was performed using the statistical package for social sciences (SPSS-16, Chicago, USA).

Independent sample t test was used to compare the mean values between cases and controls. Pearson correlation was applied to correlate between the parameters.

3. Results

As depicted in the table 1, there was significant increase in total cholesterol ($p<0.01$), triglycerides ($p<0.01$), TC/HC ratio ($p<0.001$) and AIP ($p < 0.001$) and significant decrease in HDL ($p<0.05$) in group II patients compared to group I patients. As shown in figure 1, on applying Pearson's correlation there was significant positive correlation between FPG and AIP ($r= 0.433$, $p< 0.01$) in diabetic smokers.

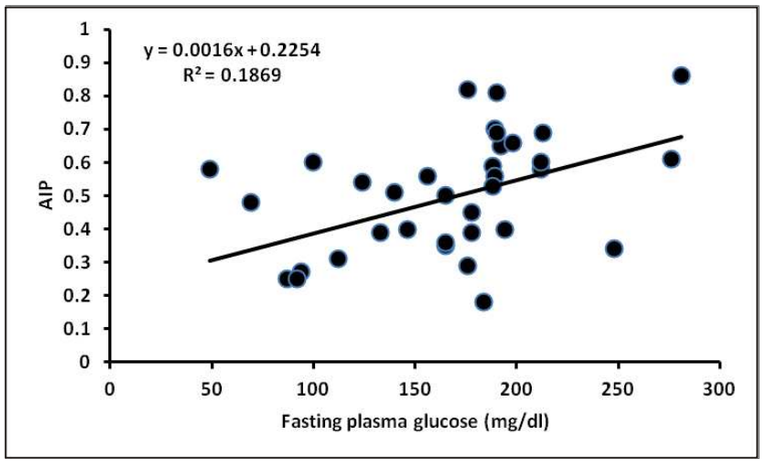

Fig. 1: Correlation graph between fasting plasma glucose and AIP of plasma in diabetic smokers

Table 1: Comparison of lipid profile and AIP between diabetic smokers and non-smokers
(Values are expressed as mean ± SD)

Parameters	Diabetic non smokers (n = 36)	Diabetic smokers (n = 36)
Age (years)	52 ± 7	53 ± 8
Weight (kilograms)	69 ± 8.5	69 ± 7.5
Duration of diabetes (years)	5 ± 4	5.5 ± 4.5
Type of diet (non veg /vegetarians)	25 + 11	26 + 10
Total cholesterol(mg/dl)	205 ± 44	242 ± 54**
Triglycerides(mg/dl)	177 ± 57	265 ± 127**
HDL (mg/dl)	37 ± 8	33 ± 8*
LDL (mg/dl)	132 ± 40	146 ± 57
TC/HC ratio	5.63 ± 1.6	7.4 ± 2.2***
AIP	0.241 ± 0.306	0.490 ± 0.196***
Fasting plasma glucose (mg/dl)	149 ± 51	165 ± 52

*p<0.05, **p<0.01, ***p<0.001

4. Discussion

In our study, we have found a significant increase in TC, TG, LDLc, TC/HC ratio and FPG glucose and a significant decrease in HDLc in diabetic smokers compared to diabetic non smokers. Previous studies have shown dyslipidemia in diabetes mellitus is closely associated with insulin resistance and hyperglycaemia, which in turn increases the glycation of proteins and generation of reactive oxygen species together contributing for oxidation of LDL and atherosclerosis.[15]

According to our study lipid profile abnormalities were more severe in smokers compared to nonsmokers. The mechanisms responsible are not clearly elucidated; the triglyceride/ high-density lipoprotein abnormalities have recently been suggested to be related to insulin resistance.[16] In fact, it has been proposed that insulin resistance is a potential key link between cigarette smoke and cardiovascular disease. In diabetic smokers, cigarette smoke contains many oxidizing substances which enhance the free radical levels and also free radical induced oxidation of LDL.[17,18] Cigarette smoke extract exposure may also decrease the plasma activity of paraoxonase, an enzyme that protects against LDL oxidation.[19] Thus smoking has added effect in the development of atherosclersosis in diabetic smokers, when compared to diabetic non smokers.

Although an independent, inverse relationship between HDL-C and cardiovascular risk has been demonstrated beyond any doubt, the contribution of TGs to cardiovascular risk has been underestimated. To overcome this, AIP was used, which takes both triglyceride and HDL levels in to consideration while calculating the atherogenicity and cardiovascular risk. Previous studies have indicated the role of AIP as early predictor of risk for development of atherosclerosis in diabetic patients. In line with previous studies, we also observed significant increase in AIP in diabetic patients, which is further enhanced in smokers as compared to diabetic non smokers.[7]

Dobiasova and Frohlich proposed the term Atherogenic Index of Plasma (AIP), to consider the risk of triglyceride and defined as log (TG/HDL-C), on the basis that people with high AIP have a higher risk for coronary artery disease than those with low AIP, that AIP is positively correlated with the fractional esterification rate of HDL (FERHDL), and that AIP is inversely correlated with LDL particle size. Because FERHDL predicts particle size in HDL and LDL, which in turn predicts the risk of coronary heart disease, the simultaneous use of TGs and HDL-C (both readily available in a plasma lipoprotein profile) as AIP may be useful in predicting plasma atherogenicity. Furthermore, insulin resistance (decreased insulin sensitivity), which is often accompanied by increased coronary artery disease risk, is also often associated with increased TG and decreased HDL-C concentrations and a predominance of small, dense LDL particles. Thus by calculating AIP can give better idea in predicting the risk for development of atherosclerosis in diabetic patients.[14]

We have observed a significant positive correlation between FPG and AIP ($r= 0.434$, $p< 0.01$) in diabetic smokers. In diabetic smokers, prolonged hyperglycaemia and insulin resistance increases the lipogenesis and increases the triglyceride concentrations and decreases the HDLc and thus may contributing for elevation of AIP levels in diabetic smokers. Previous studies have indicated the role of cigarette smoke in attenuation of insulin resistance and exact mechanism is not clear.[18] Thus in diabetic persons with poor glycaemic control and cigarette smoking has got elevated risk for development of atherosclerosis and coronary artery disease. In conclusion, AIP could be used as a simple parameter to early assessment of risk for

development of atherosclerosis in diabetic smokers.

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