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Original article

RISK FACTORS FOR CARDIOVASCULAR DISEASE (CVD) IN TYPE II DIABETES: EVALUATION OF THE ATHEROGENIC INDEX OF PLASMA, NON-HDL CHOLESTEROL, AND OTHER CARDIAC INDICES.

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Abstract.

Background:

Diseases related to cardiac problems have caused deaths in about one-third of the world, and the number may rise shortly. According to the American Heart Association, 65% of the deaths from type II diabetes are caused by cardiac diseases and stroke.

Objective: The main motive of this study was to examine the plasma for its atherogenic index, non-HDL cholesterol, and other indices that could make diabetic patients prone to cardiac diseases.

Material and Methods:

This is a cross-sectional study. The subjects who were included in this study have type II diabetes. The cases were from Bhagwan Mahavir Institute of Medical Sciences in Nalanda, Bihar. This was done on 170 patients. AIP calculator was used for the calculation of AIP values. Statistical analysis was done by using the chi-square test.

Results:

According to the study age, body mass index, sex as well and AIP have a strong correlation with TC, LDL-C, systolic blood pressure, and diastolic blood pressure. For less than 10 years, 60 people (60.3%) were suffering from type II diabetes. A total of 40 (54.1%) people did not have diabetes in their immediate family. 30 people were classified as obese according to BMI.

Conclusion:

This study showed that increasing AIP is directly related to cardiovascular risk factors. So, these risk factors influence the AIP indices. Lifestyle change, regular exercise, and a healthy diet are recommended based on the study.

Keywords: Atherogenic indices, Cardiovascular diseases, type II diabetes, arteriosclerosis, dyslipidemias., Submitted: 2023-09-05 Accepted: 2023-09-12

1. INTRODUCTION.

Diabetes is one of the most common health issues globally. Dyslipidemia is a common disorder found in type II diabetes. Cardiac disease and stroke are the common reasons for approx. 65% of deaths in type II diabetes as stated by the American Heart Association [1]. Patients with controlled blood sugar levels are also prone to cardiac diseases [2]. Thus, lipid profile becomes the major risk factor for cardiovascular diseases [3, 4]. There are strong proofs that indicate a correlation between cardiac problems and increased

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levels of bad cholesterol (LDL-C) and decreased levels of (HDL) [5,6]. Arteriosclerosis which is connected to CVD in type II diabetes is affected by many other factors like hypertension, hyperglycemia, dyslipidemia, smoking, and obesity [5]. Lipoprotein cholesterol glycation may occur in diabetic patients which in turn leads to the oxidation of LDL molecules and the formation of arteriosclerosis plaque [7, 8]. One of the po- tent indices of atherogenicity is an atherogenic in- dex of plasma(AIP) which is certainly correlated with cardiovascular diseases [8]. AIP becomes the restorative tracker parameter for cardiovascular disorders in diabetes patients [9]. The atherogenic index takes low-density lipid cholesterol into account, as LDL-C is the major determinant of cardiovascular disease. Many studies testify that AIP is a strong predictor of cardiac events. If it is monitored regularly, it can provide a further indication of cardiac events well ahead of time.

There are other conventional assessment indexes to inspect CVD risk, for example, cardiogenic risk ratio and atherogenic coefficient. However, AIP is more accurate in making such a predicament. The difference between total and HDL cholesterol is non-HDL cholesterol and thus contemplates the sum of cholesterol carried on potentially prothrombotic apolipoprotein B protein-containing particles [10].

Health professionals are more interested in providing suitable treatment for diabetes patients to achieve the best glycemic control [11]. Glycemic control and lipid profile are very closely related so these conditions must be observed to avoid diabetes-related microvascular and macrovascular complications [12]. This study aims to analyze cardiovascular complication risk by utilizing the atherogenic index of plasma and other factors that influence type 2 diabetes mellitus.

2. MATERIAL AND METHODS.

2.1. Study design.

It was an analytical study.

2.2. Study setting.

This study was carried out at Bhagwan Mahavir Institute of Medical Sciences, Pawanpuri, Nalanda, Bihar for 60 days.

2.3. Study size.

A total of 170 patients were taken in this study.

2.4. Statistical method.

Statistical analyses were done using SPSS version 25.0 software.

The study was of an analytical design with a cross-sectional approach. A total of 170 subjects were taken with type II diabetes in Bhagwan Mahavir Institute of Medical Sciences, Nalanda, Bihar. The inclusion criteria for this study are the patients with type II diabetes who gave consent for this study. Also, patients who agreed to abide by the daily routine activities required to be performed by themselves. On the other hand, the subjects that were excluded from the study were those who had a previous history of cardiac diseases, subjects who had reduced consciousness, pregnant women with type II diabetes, and vascular abnormalities.

Informed consent was taken from all the subjects included in the study. Body weight and height measurements were performed for the examination of anthropometry. A sphygmomanometer was used for the measurement of blood pressure (BP) after 5 minutes. Blood samples for fasting blood sugar level (FBS), HbA1c, and lipid parameters were collected after 10 hours of overnight fasting.

The data obtained in the study was statistically analyzed with the help of a chi-square test. Correlation between AIP and various parameters using Pearson's value.

AIP was calculated as:

AIP= log (TG/HDL-C)

3. RESULTS.

The majority of the patients were females, 110 patients of 30-40 yrs of age (84.5%). For less than 10 years, 80 people (60.3%) had been suffering from type II diabetes. A total of 60 (54.1%) people did not have diabetes in their immediate family. 60 people were classified as obese according to BMI. It was also investigated that 120 people

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Table 1: **Attributes of patients with typeII diabetes.**

Attributes	**No. of patients**	**Percent-age**
Sex:	110	80.6
Women	60	19.4
Men		
Family history of diabetes	40	18.2
Maternal	40	18.2
Paternal	60	54.1
None	30	9.7
Both		
Age:	140	84.5
30 to 40yrs	30	13.6
40 to 50yrs		
Time of diagnosis:	80	60.3
Less than 10 years	40	24
Between 10 to 15 years	30	13.4
Between 15 to 20 years	20	2.3
More than 20 YEARS		
Body mass index (BMI):	20	9.5
Underweight	90	50.5
Normal weight	60	40
Obese		
Blood pressure (systole):	50	20.4
Normotensive	120	79.6
Hypertensive		
AIP:	40	34.2
Negligible risk	20	10.5
Moderate risk	110	55.3
High risk		
Lifestyle:	40	22.3
Highly active	30	15.3
Moderate Activity	100	62.5
Sedentary		

(79.6%) had hypertension. Based on lifestyle, 100 (62.5%) had low physical activity. According to AIP calculation, 110 people (55.3%) were prone to cardiac diseases.

4. DISCUSSION.

From the study, it is evident that most of the patients had dyslipidemia. Type II diabet- ics have many fold chance of having cardiovas- cular events than nondiabetics. High triglyc- eride and low HDL-C levels are very common lipid traits found to be strongly correlated with cardiovascular events in diabetics. It has been well-documented that triglyceride-rich lipopro- teins (TRL) are involved in atherogenesis in many ways. Moreover, HDL is responsible for facilitat- ing cholesterol efflux from lipid-rich macrophages within atherosclerotic plaques in the arterial walls besides peripheral cells. This efflux and dis- posal of bad cholesterol is mediated by adeno-

Table 2: **Range and mean values of data obtained.**

Parameters	Mean values	Range
Fasting blood sugar level	250 mg/dL	88-601 mg/dL
HbA1c	10.0%	6.30-16.80%
Total cholesterol	238 mg/dL	149-457 mg/dL
High-density lipid	46.50 mg/dL	20-76 mg/dL
Low density lipid	151.10 mg/dL	40-376 mg/dL
Total Triglyceride	215 mg/dL	53-1224 mg/ mg/dL

Table 3: **Correlation between AIP with recorded parameters.**

Parameters	Pearson's value
Fasting blood sugar levels	0.142
Increases triglycerides	0.0001
Decreased high-density lipid	0.0001
Increases low-density lipid	0.242
Increased HbA1c	0.36

* p-value < 0.005 is considered to be significant.

sine triphosphate-binding cassette transporter A1 (ABCA1). The cholesterol is then transported to the hepatocytes for further metabolism and excretion through bile [14]. Furthermore, HDL has anti-inflammatory and anti-oxidative effects by regulating endothelial homeostasis and anti-thrombus through attenuation of platelet aggregation and adhesion responses [15]. Thus, AIP, the logarithmic ratio of TG/HDL is a powerful atherogenic index. Other indices e.g. Framingham heart score and Atherosclerotic cardiovascular disease (ASCVD) risk score are also used. However, AIP is considered to be a good and sensitive one for predicting atherosclerosis and other cardiovascular events in diabetic patients [9]. Various growing pieces of evidence also suggest its strong association with numerous cardiovascular risk factors, e.g. BMI, obesity, hypertension, Triglycerides, hyperglycemia, etc.[16].

Dyslipidemia is frequently associated with type II diabetes mellitus. Dyslipidemia is a conventional risk factor for CAD. LDL particles are created from high triglyceride levels, high low-density lipid cholesterol, and low high-density cholesterol levels [5]. Fasting blood sugar level is inversely related to HDL-C and has a direct correlation with total cholesterol, low-density lipid cholesterol, total cholesterol, and triglyceride.

AIP can be considered as a reliable indicator for predicting cardiovascular diseases and its complications. It has a few advantages like:-

- *It helps in normal distribution after logarithmic transformation.*
- *Direct calculation can be done by AIP without any additional cost.*
- *AIP can function indirectly as a substitute for LDL particle size* [17].

According to the American Heart Association, there is a risk calculator that can be utilized in predicting atherosclerotic cardiovascular disease over the next 10 years [18]. A risk factor-based application was opted for the initiation of statin therapy by the American diabetes association of standard diabetes. Statin therapy comprises the following variables presence and absence of risk factors and history of cardiac problems. The common risk factors for CAD are smoking, LDL-C >100 mg/dl, and premature ASCVD in the family. Patients with positive atherosclerotic cardiovascular disease events should be getting high

amounts of statin as therapy irrespective of their age. High statin therapy is also suggested in patients between the ages of 35 and 70 years without any ASCVD events but with the existence of cardiac risks [19]. Definite determination of specific individual risk can pave a pathway to prevent atherosclerotic cardiovascular disease.

The connection of AIP with other risk factors of cardiovascular disease was evaluated in this study. Based on the outcomes a link was found between FBS and HbA1c, low-density lipid cholesterol, high-density lipid cholesterol, and total cholesterol with atherogenic indices but only LDL-C was unrelated to AIP. In a study stated earlier the patients with higher AIP are at higher risk of atherosclerotic plaque [20]. In a study on Korean adults, AIP was significantly related to the progression of coronary calcification [21]. Apart from these patients with elevated AIP have an elevated uric acid. There is an important correlation between AIP and uric acid, uric acid is a risk factor for AIP. The uric acid level of the serum is also related to cardiac problems, Obesity, high blood pressure, etc. Hyperuricemia may lead to many life-threatening metabolic disorders like diabetes and cardiac diseases. This risk can be due to oxidative stress, inflammation, and endothelial dysfunction that occurs because of the increased uric acid level.

5. CONCLUSION.

The study shows a positive relationship between AIP and cardiovascular risk factors in type II diabetes. Thus, it can be used as a noninvasive bio marker for the prediction and evaluation of atherosclerosis. Therefore, AIP can independently serve as a predictive factor for CAD and its severity in type II diabetes.

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