Assessment Of Atherogenic Index of Plasma as A Marker of Coronary Artery Diseases in Type 2 Diabetes Mellitus Patients

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ABSTRACT

Background: Coronary artery disease (CAD) encompasses a range of diseases that result from atheromatous change in coronary vessels. Diabetes mellitus (DM) and CAD are closely related where DM is an important risk factor for CAD. High values of Atherogenic index of plasma (AIP) are associated with high cardiovascular risks.

Aim of the study: to identify the value of AIP as a marker for CADs in type 2DM patients.

Subject and Methods: This case-control study was carried out in Cardiology Department, Zagazig University Hospitals. This study included 140 type 2 DM patients. They were classified into two main groups: Group (1): 70 type 2 DM patients with evidence of CADs. Group (2): 70 type 2 DM patients with no evidence of CADs (admitted complaining of symptoms of angina or CA showing no significant stenotic lesions). All patients were subjected to full history taking, cardiovascular risk profile, laboratory investigation including glycosylated hemoglobin test and fasting and 2-hour postprandial blood glucose level and angiographic examination. Atherogenic Index of Plasma (AIP) was calculated.

Results: 57% of patient presented with history of CADs showed RWMA from of hypokinesia, moreover 25% had associated akinesia. Regarding non-CADs group 31% had RWMA in from of hypokinesia. CAD group had significantly higher regard AI than No CAD group as AI was distributed as 0.61±0.21 and 1.02±0.31 respectively between No CAD and CAD groups respectively. AI was significantly positive correlated with TG and LDL but significantly negatively correlated with HDL, with no other significant correlation. Highest vessel affected was LAD, and single were 44.3% and multiple were 55.7%. From all dependent predictors we found that abnormal finding in ECHO, LDL, and AI were the only independent predictors.

Conclusions: From these results, we found high-risk susceptibility to develop CVD and unstable angina with high level of AIP in type 2 diabetic subjects, compared to other patients with low level of AIP. So, AIP is an atherogenic factor to assess cardiovascular events. Therefore, AIP may be a good marker.

Keywords: Atherogenic Index of Plasma (AIP), Coronary Artery Diseases, Type 2 Diabetes Mellitus (T2DM).

I. INTRODUCTION

Coronary artery disease (CAD) encompasses a range of diseases that result from atheromatous change in coronary vessels, in the past CAD was thought to be a simple inexorable process of artery narrowing, eventually resulting in complete vessel blockage, however in recent years the explanatory paradigm has changed because it was realized that a whole spectrum of coronary plaques exists from stable (lipid-poor) to unstable (lipid-rich) (1).

Type 2 DM has recently been described as "coronary risk equivalent". Lipoprotein metabolism disorder in type 2 DM is known as diabetic dyslipidemia. Dyslipidemia contributes to a substantial percentage in cardiovascular mortality and morbidity in diabetic patients. Diabetic patients tend to have higher serum levels of triglycerides (TGs), lower high-density lipoprotein cholesterol (HDL-C), and similar serum values for low-density lipoprotein cholesterol (LDL-C) when compared with non-diabetic patients. However, diabetic patients tend to have a higher concentration of smaller and denser LDL particles, which are associated with higher (CAD) risk (2).
Diabetes mellitus is associated with a considerably increased risk of premature atherosclerotic cardiovascular disease. Intensive glycemic control has essentially failed to significantly improve cardiovascular outcomes in clinical trials. Dyslipidemia is common in diabetes and there is strong evidence that cholesterol lowering improves cardiovascular outcomes, even in patients with apparently unremarkable lipid profiles (3).

Dyslipidemia was defined according to the American Heart Association classification corresponding to the 95th percentile in a American population as total cholesterol >5.2 mmol/L (200 mg/dl), LDL > 3.4 mmol/L (130 mg/dl), HDL <0.9 mmol/L (35 mg/dl), or triglycerides >1.7 mmol/L (150 mg/dl), or a combination thereof (4).

Atherogenic index of plasma (AIP), the logarithm of the molar ratio of TG to HDL-C, was first described by Dobiášová and Frohlichin (5): AIP is based on two important parameters, serum triglyceride, and serum HDLc. The concurrent use of triglycerides and HDLc in this ratio reflects the multiple interactions among the metabolism of different lipoproteins and can be useful for predicting plasma atherogenicity (6).

AIP values of -0.3 to 0.1 are associated with low, 0.10-0.24 with medium and above 0.24 with high cardiovascular risk (6).

It is calculated according to the following formula: AIP = Log (serum triglyceride/serum HDLc) (5).

AIP has a stronger sensitivity that reflects the interaction between atherogenic and protective lipoprotein. In recent years, a growing body of evidence has indicated that AIP is a strong marker to determine the risk of CAD (5).

Based on these data, the aim of this study is to investigate the significant value of AIP as an important risk factor for CAD in Type 2DM.

**II-STUDY DESIGN AND PARTICIPANTS**

This case-control study was carried out in Cardiology Department, Zagazig University Hospital. It included 140 DM patients. Patients were selected from those who have type 2 diabetes mellitus. They were classified into two main groups: Group (1): 70 type 2 DM patients with evidence of CADs. Group (2): 70 type 2 DM patients with no evidence of CADs (admitted complaining of symptoms of angina or CA showing no significant stenotic lesions).

**Inclusion criteria:**

- Patients having diabetes mellitus type 2 (NIDDM), estimated by the glycaemic variability, and free of complications.
- Referral to coronary angiography in patients with a history of CAD, due to chest pain. Coronary angiography was performed via the femoral or radial approach, using Gensini score, which is the simplest way to assess severity of CAD.

**Exclusion criteria:**

- Patients with any of the following were excluded:
  - Diabetic subjects with smoking, alcoholism, hypertension, liver disease and kidney disease.
  - Patients who did not undergo coronary angiography.
  - Type 1 DM patients.
  - Patients with hypothyroidism or nephrotic syndrome.
  - Patients taking lipid-lowering medications or antioxidants for more than 6 months.
  - Psychiatric patients were excluded.
All patients were subjected to:

Complete history taking:
With special emphasis on age, sex, history of coronary artery disease, risk factors including [hypertension, diabetes mellitus (regarding duration of therapy and drug history), smoking and family history of ischemic heart disease], chest pain, previous myocardial infarction, previous catheterization or revascularization

Physical examination:
Full general and local examination with special emphasis on pulse rate, rhythm, blood pressure measurements (systolic and diastolic), measurement of waist circumference and calculation of Body Mass Index (BMI) by measuring patient weight divided by the square of height in meters. Weight and height were measured and documented by a nurse at the time of CA. If patients were unstable, self-reported weight and height were collected and BMI calculated. Patients were grouped according to three BMI categories using the World Health Organization classification system: normal (18.5–24.9 kg/m2), overweight (25.0–29.9 kg/m2), and obese class > 30 kg/m2

Diagnostic tools:

Electrocardiogram:
An electrocardiogram (ECG) with 12-lead recording at rest to look for signs of related CADs.

New ST elevation at J point in two contiguous leads with cut-points of 0.1 mV or less was necessary in all leads except V1–V3, where elevation of 0.2 mV or less was required for STEMI in the ECG. In the absence of STEMI criteria, new horizontal or down-sloping ST depression 0.05 mV in two adjacent leads or T-wave inversion 0.1 mV in two adjacent leads with strong R wave or R/S ratio >1 or both were judged to be confirmed ischemia abnormalities (7)

ECG interpretations included (I) no ischemia changes; (II) infarction if STEMI criteria were satisfied; (III) definite ischemic ECG abnormalities in the absence of STEMI criteria in the anterior (V1–V4), inferior (II, III, aVF), or lateral (V5–V7) heart regions (I, aVL, V5, V6) (8).

Echocardiography (ECHO):
Analyze and report on the function of the left ventricle. Using a Phillips HD7 machine and a probe S4, we performed a transthoracic echocardiogram within 2-3 days of admitting the patient. LV Based on these results, Modified Simpson's approach was used to determine heart rate synchrony. The American Society of Echocardiography's guidelines for recording and calculating various parameters were followed (9).

EF was calculated using 2D volume measurements, the biphase Simpson's approach, as the primary output. When viewing the left ventricle from the top, researchers looked at the volumes in the apical four chamber (A4C), as well as the top two chamber (A2C). As the frame with the smallest cavity area, end systole was chosen, and as the frame with the largest LV cavity area, end diastole was chosen. For each view, the EF was determined using the formula below: In other words, EF (percent) is \[ \frac{(EDV - ESV)}{EDV} \] by 100 times (9).

Laboratory tests:
LDL-C, HDL-C, triglycerides, glycerol oxidase, and non-HDL-C lipid profiles are all measured using the autoanalyzer, along with total cholesterol, HDL-C, immunoinhibition, and non-HDL-C triglycerides. (10) Glycosylated hemoglobin (HbA1c) test.
Fasting and 2-hour postprandial blood glucose level.

Coronary angiography:
Coronary angiography was performed by the Judkins technique without nitroglycerin using 6-French right and left heart catheters to assess condition of epicardial arteries and their lesions (10).
Clinical state and laboratory measures had no bearing on how the interventional cardiologists evaluated the angiograms. Two cardiologists independently interpreted each angiogram after it had been obtained using normal methods. (8). Multiple projections of coronary angiography were used to properly analyse the target lesions (9).

The percentage of luminal diameter stenosis in the coronary arteries was calculated by visually estimating the degree of constriction. In patients with LAD, circumflex artery, right coronary or major branch constriction of 70 percent and 50 percent of the left main coronary artery, severe angiographic artery disease was identified (6).

**Gensini score:**
A common grading method in cardiovascular medicine is the Gensini score, which considers factors such as location, degree of luminal constriction, and the overall effect of various blockages. The reduction in lumen diameter indicates the severity of stenosis, and each lesion is given a nonlinear score based on it. This score is calculated by adding together all of the lesion scores.

**Statistical Analysis**
Revision, coding and tabulation of the gathered data had been completed on a PC with the help of the Statistical package for Social Science (SPSS version 20.0 for windows; SPSS Inc, Chicago, IL,2001). Presented data had been subjected to appropriate analysis based on the type of data collected for each parameter. T test reveals differences between two sets of quantitatively independent samples. For statistically significant results, the P value was set at 0.05, and for very significant results, it was set at 0.001.

**III. RESULTS**
Age was distributed as 60.01±8.41 and 58.92±7.38 between No CAD and CAD respectively without significant difference between groups, regard sex distribution male was significantly associated with CAD cases (figure 1,2).

CAD group were significantly higher regard TG and LDL distribution than No CAD group (figure 3).

By calculating wall motion normal=1, hypokinesia =2, akinesia =3 for the scoring system subdivided by 16 segments. About 57% of patient presented with history of CADs showed RWMA inf rom of hypokinesia, moreover 25% had associated akinesia. Regarding non-CADs group presenting with chest pain with no history of CADs treatment only 10 patients with value of 7% had a kinetic segment, however about 44 patients with value 31% had RWMA in from of hypokinesia. Value of 1.5 or more is associated with hypokinesia, akinia whereas value of 1is associated with normal wall motion and good ejection fraction (table 1).

CAD group were significantly higher regard GENUSINI score (table 2).

CAD group were significantly higher regard AI than No CAD group as AI was distributed as 0.61±0.21 and 1.02±0.31 respectively between No CAD and CAD groups respectively (table 3).

AI was significantly positive correlated with TG and LDL but significantly negatively correlated with HDL, with no other significant correlation (table 4).

ROC Curve for CAD cutoff regard AI showed significant area under curve with cutoff >0.72 with sensitivity 83.3% and specificity 70.0% (figure 4).

Highest vessel affected was LAD , and single were 44.3% and multiple were 55.7% (table 5).

From all dependent predictors we found that abnormal finding in ECHO, LDL, and AI were the only independent predictors (table 6).
Figure (1) age distribution between studied groups (coronary artery disease)

Figure (2): sex distribution between studied groups CAD

Figure 3: Bar diagram with error bars showing: mean LDL distribution in groups.

Table 1: Wall motion score index

<table>
<thead>
<tr>
<th>Wall motion</th>
<th>CAD</th>
<th>Non-CAD</th>
<th>Scoring</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>hypokinesia</td>
<td>80</td>
<td>44</td>
<td>&gt;2</td>
<td>57%</td>
</tr>
<tr>
<td>Normal</td>
<td>70</td>
<td>34</td>
<td>1</td>
<td>50%</td>
</tr>
</tbody>
</table>
Table 2: GENSINI distribution between studied groups

<table>
<thead>
<tr>
<th></th>
<th>No CAD</th>
<th>CAD</th>
<th>Mann Whitney</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENSINI</td>
<td>2.94±1.31</td>
<td>32.87±21.58</td>
<td>-6.050</td>
<td>0.00**</td>
</tr>
<tr>
<td></td>
<td>0 (0-48)</td>
<td>24 (0-312)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Atherogenic index of plasma distribution between groups

<table>
<thead>
<tr>
<th></th>
<th>No CAD</th>
<th>CAD</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI</td>
<td>0.61±0.21</td>
<td>1.02±0.31</td>
<td>-2.957</td>
<td>0.004*</td>
</tr>
</tbody>
</table>

Table 4: Correlations of AI with other parameters

<table>
<thead>
<tr>
<th></th>
<th>AI</th>
<th>r</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE</td>
<td></td>
<td>-.081-</td>
<td>.343</td>
</tr>
<tr>
<td>BMI</td>
<td></td>
<td>.058</td>
<td>.500</td>
</tr>
<tr>
<td>FBG</td>
<td></td>
<td>.132</td>
<td>.122</td>
</tr>
<tr>
<td>2H PP</td>
<td></td>
<td>-.005-</td>
<td>.953</td>
</tr>
<tr>
<td>TG</td>
<td></td>
<td>.254**</td>
<td>.003</td>
</tr>
<tr>
<td>HDL</td>
<td></td>
<td>-.309-**</td>
<td>.000</td>
</tr>
<tr>
<td>LDL</td>
<td></td>
<td>.187*</td>
<td>.027</td>
</tr>
<tr>
<td>HbA1C</td>
<td></td>
<td>.098</td>
<td>.249</td>
</tr>
<tr>
<td>SBP</td>
<td></td>
<td>.087</td>
<td>.309</td>
</tr>
<tr>
<td>DBP</td>
<td></td>
<td>.030</td>
<td>.729</td>
</tr>
<tr>
<td>HR</td>
<td></td>
<td>-.023-</td>
<td>.789</td>
</tr>
<tr>
<td>GENSINI</td>
<td></td>
<td>.144</td>
<td>.111</td>
</tr>
</tbody>
</table>

Figure 4: ROC Curve for CAD cutoff regard AI
Table 5: Vessels affected distribution among cases only

<table>
<thead>
<tr>
<th>Vessel</th>
<th>Not</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>LAD</td>
<td>Not</td>
<td>8</td>
<td>11.4</td>
</tr>
<tr>
<td></td>
<td>Affected</td>
<td>62</td>
<td>88.6</td>
</tr>
<tr>
<td>LCX</td>
<td>Not</td>
<td>35</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Affected</td>
<td>35</td>
<td>50.0</td>
</tr>
<tr>
<td>RCA</td>
<td>Not</td>
<td>35</td>
<td>50.0</td>
</tr>
<tr>
<td></td>
<td>Affected</td>
<td>35</td>
<td>50.0</td>
</tr>
<tr>
<td>Vessel</td>
<td>Single</td>
<td>31</td>
<td>44.3</td>
</tr>
<tr>
<td></td>
<td>Multiple</td>
<td>39</td>
<td>55.7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>70</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 6: Multivariate logistic regression independent predictors for CAD

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Wald</th>
<th>P</th>
<th>OR</th>
<th>95% C.I. for Lower</th>
<th>95% C.I. for Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex /male</td>
<td>1.010</td>
<td>0.921</td>
<td>1.925</td>
<td>0.199</td>
<td>4.299</td>
</tr>
<tr>
<td>ECHO abnormal finding</td>
<td>4.530</td>
<td>0.033*</td>
<td>12.327</td>
<td>1.220</td>
<td>124.580</td>
</tr>
<tr>
<td>BMI</td>
<td>2.346</td>
<td>0.126</td>
<td>1.222</td>
<td>0.945</td>
<td>1.580</td>
</tr>
<tr>
<td>FBG</td>
<td>2.093</td>
<td>0.148</td>
<td>1.009</td>
<td>0.997</td>
<td>1.021</td>
</tr>
<tr>
<td>HA1C</td>
<td>1.651</td>
<td>0.199</td>
<td>1.404</td>
<td>0.837</td>
<td>2.355</td>
</tr>
<tr>
<td>TG</td>
<td>0.829</td>
<td>0.365</td>
<td>1.989</td>
<td>0.866</td>
<td>3.128</td>
</tr>
<tr>
<td>LDL</td>
<td>7.743</td>
<td>0.005*</td>
<td>1.084</td>
<td>1.024</td>
<td>1.148</td>
</tr>
<tr>
<td>SBP</td>
<td>1.051</td>
<td>0.305</td>
<td>1.054</td>
<td>0.953</td>
<td>1.165</td>
</tr>
<tr>
<td>DBP</td>
<td>0.005</td>
<td>0.942</td>
<td>1.995</td>
<td>0.868</td>
<td>3.141</td>
</tr>
<tr>
<td>AIP</td>
<td>7.143</td>
<td>0.008*</td>
<td>1.160</td>
<td>0.537</td>
<td>2.505</td>
</tr>
</tbody>
</table>

IV. DISCUSSION

Cardiovascular disease (CVD) represents the leading cause of mortality in developed countries. Great reduction in mortality has been achieved by improvement in myocardial revascularization techniques. Despite the great improvement of revascularization techniques and antithrombotic therapies for the treatment of CAD, the results are still unsatisfactory in high-risk subgroups of patients. Therefore, large interests have been focused on the identification of new risk factors for coronary artery disease (CAD) (such as smoking, hypertension, diabetes, overweight, and high cholesterol can help to prevent and reduce disease burden) and its prevention (11).

Dyslipidemia is the primary metabolic abnormality that occurs in diabetes mellitus to develop complications. Hypertriglyceridemia, low High Density Lipoprotein (HDL) and increased Low Density Lipoprotein (LDL) were considered as atherogenic factors in patients with type 2 diabetes mellitus. Insulin resistance is the major motivating factor for dyslipidemia (12).

Diabetic patients usually present various factors contributing to the risk of cardiovascular diseases, which include hyperglycemia, fluctuation of blood glucose, central obesity, hyperlipidemia and hypertension. Glycemic disorders are important components of these risk factors (13).

Gorus et al. (14) have established those cardiovascular complications are mainly or partly dependent on sustained chronic hyperglycemia. This glycemic disorder can be estimated as a whole from the determination of hemoglobin A1c (HbA1c) level, which integrates both basal and postprandial hyperglycemia.

Khazaal (15) proposed the term AIP, defined as log (TGL/HDL-c). It is a critical index that can be used as a stand-alone index for cardiac risk estimation. Individuals with high AIP have a higher risk of Coronary Heart Disease (CHD) than those with low AIP. TGL and HDL-c were predictable markers for CHD risk; hence AIP may be useful for the prediction of atherogenicity.
AIP can act as an adjunct over the individual lipid profile. AIP is the best determinant for fractionated esterification rate of HDL-C and more useful than routine lipid parameters. It can be used as a diagnostic indicator when the other atherogenic risk parameters appear normal. The AIP calculation estimates the values of “zone of atherogenic risk” (16).

Improved quality of life has brought upon an increase in the average life expectancy from 68.9 to 73.5 years for males and from 71.7 to 74.5 years for females between 1990 and 2007. However, at least one type of CVD risk factor is still present in 61% of the adult population (17).

In our study, age was distributed as 60.01 ± 8.41 and 58.92 ± 7.38 years between no CAD and CAD respectively without significant difference between the two groups. Turfana et al. (18) had shown that age as a risk factor for coronary artery disease play an important role in assessing the severity of CAD as there was a significant difference between the SYNTAX score groups. Nozue et al. (19) studied the aging effect on the coronaries and found that coronary atherosclerosis was more advanced in the elderly patients because external elastic membrane (EEM) and plaque volume at baseline were significantly greater than in the non-elderly patients.

Regarding sex distribution, males were significantly associated with CAD cases. In agreement, Ghem et al. (20) found that male gender is a risk factor for developing a severe coronary atherosclerosis, this may be explained by the sample size in their study was composed mainly of males. But, Turfana et al. (18) had found no significant difference between different gender in the severity of CAD.

In our study, CAD group was significantly higher regarding TG and LDL distribution than no-CAD group. Kumawat et al. (21) have reported significantly higher levels of triglycerides, VLDL cholesterol and significantly lower level of HDL cholesterol in patients with type 2 diabetes than in healthy controls. Gupta and Chari (22) have observed significantly altered levels of total cholesterol, triglyceride, LDL cholesterol, VLDL cholesterol, and HDL cholesterol in diabetic patients with Ischaemic Heart Disease (IHD) than without complications.

Palem and Abraham (23) showed significantly high levels of TG, LDL and VLDL in type 2 diabetic subjects than healthy controls. But there was no significant difference in the level of TC and HDL among the study groups.

In our study, CAD group was significantly associated with abnormal echocardiographic findings and Gensini score. Also, CAD group was significantly higher regarding AIP than no-CAD group as AIP was distributed as 0.61 ± 0.21 and 1.02 ± 0.31 respectively between no-CAD and CAD groups respectively. Sujata and Kavitha (24) have identified increased AIP in obese women with and without Metabolic Syndrome (MetS) than normal women. They also stated that AIP was associated with TGL/HDL-c, LDL/HDL-c, MI and CVD. It has also shown strong association of AIP with triglyceride and LDL, and predicted as risk of CVD death. Cai et al. (25) also indicated that AIP was significantly associated with coronary artery disease.

Palem and Abraham (23) showed significantly high level of AIP in type 2 diabetic subjects than healthy controls. Wu et al. (26) linked between AIP and risk of CAD among postmenopausal women, suggesting that AIP might be a strong marker for predicting the risk of CAD in postmenopausal women.

As we know, hyperglycemia itself develops dyslipidemia, oxidative stress, ED and finally to cardiovascular risk in diabetic subjects; correlation analysis showed that AIP was significantly correlated with TG and LDL, but significantly negatively correlated with HDL, with no other significant correlation.

Niroumand et al. (27) assessed the correlation between AIP, as a major risk factor of CVD, and the other important factors, like physical activity, BMI, waist circumference, HTN, FBS and lipid status. They showed that increasing in AIP is associated with other cardiovascular risk factors; therefore change in these risk factors affects the AIP index. Lifestyle change, performing regular exercise and healthy diet modification is recommended. In addition, AIP should be used as a regular monitoring index of CVD in every day practice, especially in persons with another cardiovascular risk factors. It is also associated with other major risk factors of heart disease and it is sensitive measure that can be easily calculated especially
when other lipid values are within normal range.

Palem and Abraham (23) have proved that AIP is a significant factor for CVD risk than lipid profile level. Bo et al. (28) implemented the relationship between AIP and other CVDs risks among university staff in order to highlight that AIP rather than lipid profile is the predictor for CVDs. They showed that there was a significant correlation between AIP and CVD risk factors (BMI, visceral fat, body fat, total cholesterol, LDL cholesterol, triglyceride, glucose, and HDL cholesterol) among the studied samples. Multivariate logistic regression found that abnormal echocardiographic findings, LDL, Gensini score and AIP were the only independent predictors for CAD. Zhu et al. (29) supported the theory that AIP predicts the risk of development of type 2 diabetes mellitus better than traditional lipid markers. Regmi et al. (30) evaluated the utility of AIP in diabetic and prediabetic population for prediction of future CVD. They concluded that AIP is good indicator of future CVD in both diabetes and prediabetes.

Palem and Abraham (23) estimated whether AIP will be a strong indicator for predicting cardiovascular risk in addition to endothelial dysfunction in type 2 diabetes mellitus. They found negative correlation of AIP with NO. Hence, estimation of NO in addition to AIP can be a strong indicator for predicting CVD in type 2 diabetic subjects.

STUDY LIMITATION

• The results were obtained from a single medical center (Zagazig University Hospitals).
• Sample size was small. Facts that make it difficult to generalize our results to cover all patients with coronary artery disease.
• Assessment of coronary artery disease by a rough method subjective.
• Some factors, such as different diets, physical and emotional stress etc., which may affect levels of glucose fluctuations couldn’t be all prevented.

V. CONCLUSION

From these results, we found high-risk susceptibility to develop CVD and unstable angina with high level of AIP in type 2 diabetic subjects, compared to other patients with low level of AIP. So, AIP is an atherogenic factor to assess cardiovascular events. Therefore, AIP may be a good marker.

For prevention of the CVD risk, early intervention programs such as exercise, dietary control, and monitoring of AIP especially for those who are in the high-risk category should be carried out regularly. Further studies with larger sample size are recommended. A further follow-up should be evaluated well for out-coming. Multi-center sampling supports such tools to increase validity.

REFERENCES


