International Journal of Science and Research Archive
eISSN: 2582-8185
Cross Ref DOI: 10.30574/ijsra
Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

A prospective study of correlation between microalbuminuria and atherogenic index in evaluating coronary vascular risk in newly diagnosed type 2 diabetes mellitus patients

DEEPESH MAKHIJANI *, GAJENDRA MAHISHALE and BILAL BIN ABDULLAH

Department of General Medicine, Al-Ameen Medical College and Hospital, Vijayapura, Karnataka, India.

International Journal of Science and Research Archive, 2024, 13(02), 1080–1087

Publication history: Received on 07 October 2024; revised on 14 November 2024; accepted on 17 November 2024

Article DOI: https://doi.org/10.30574/ijsra.2024.13.2.2241

Abstract

Background: Diabetes mellitus is an important factor associated with increased cardiovascular morbidity and mortality. Today, it is recognized that the presence of microalbuminuria, in addition to being a marker of incipient renal disease in diabetic patients, seems to be also a marker of large vessel disease, and is associated with an increased cardiovascular mortality. AIP-related risk factors and their relationship with vascular plaques in patients with T2DM is also a concern. The possibility of AIP as a predictor along with microalbuminuria and follow-up monitoring of these factors in patients with newly diagnosed type 2 diabetes has to be explored.

Materials and methods: This Prospective Observational study was conducted in the AL AMEEN MEDICAL COLLEGE AND HOSPITAL, VIJAYAPUR. 250 cases of Newly diagnosed type 2 Diabetes Patients from the medicine ward and OPD's were included in the study excluding the exclusion criteria. Anthropometric measurements were done with blood investigations and Urine Microalbumin examination.

Results: In this study while comparing atherogenic indices and microalbuminuria, positive correlation (®=0.70*) were present and results were found to be highly significant. Mean ±SD of M. albuminuria in group A and group B was 17.944±5.4420 and 81.640±61.7519. Mean ±SD of AIP in group A and group B was 0.4026±0.06527 and 0.6014±0.10584. Results were found to be highly significant.

Conclusion: AIP is an independent risk factor for CVD and in correlation with MAU could predict the occurrence of coronary vascular risk in newly diagnosed T2DM patients. AIP and MAU correlation provides clinicians a reliable basis to identify high-risk patients and formulate treatment strategies

Keywords: Plasma arteriosclerosis index; Microalbuminuria; Type 2 diabetes; Dyslipidemia

1. Introduction

Diabetes mellitus is an important factor associated with increased cardiovascular morbidity and mortality, due to coronary artery disease (CAD), stroke and peripheral vascular disease. Age adjusted coronary artery disease prevalence in diabetic patients, in the United States, is between 30 and 51%; peripheral vascular disease and stroke prevalence are 9 and 10%, respectively. Recently, a study in Brazil reported a 2.3 greater in-hospital mortality rate in diabetic compared with nondiabetic patients, and the main cause of death was cardiovascular disease.[1]

Today, it is recognized that the presence of microalbuminuria, in addition to being a marker of incipient renal disease in diabetic patients, seems to be also a marker of large vessel disease, and is associated with an increased cardiovascular

* Corresponding author: DEEPESH MAKHIJANI

disease mortality, especially coronary heart disease. This increased mortality is due, in part, to a greater prevalence of other risk factors in patients with microalbuminuria, such as lipid disorders, hypertension (H), increased fibrinogen levels and blood rheology changes.[2]

Recent studies from the World Health Organization demonstrated that the presence of proteinuria, in type 2 diabetic patients (DM2), increased the risk of cardiovascular death 3 to 4 times, independent of other risk factors .[3]

The presence of microalbuminuria possibly reflects the process of generalized vascular damage, affecting simultaneously glomeruli, the retina and the intimal layer of large vessels. This has been demonstrated by studies of markers of endothelial dysfunction and measurements of transcapillary protein leakage.[4]

Some studies suggested a common genetic predisposition for microalbuminuria and the early atherosclerotic process in diabetic patients. Others suggested that glomerular mesangial cells and arterial smooth muscle cells, being both of mesenchymal origin, would suffer the same changes in response to the different metabolic abnormalities observed in these patients, such as functional extracellular matrix changes with the consequent mesangial and medial proliferation, endothelial dysfunction and protein leakage.[5]

Clinically, when microalbuminuria occurs in diabetic patients, it indicates that they have entered the early stage of DKD, which can be reversed if the disease is actively prevented and treated. Therefore, early detection, prevention and intervention of microalbuminuria are significant.[5]

In 2001, Dobiasova et al put forward the concept of plasma atherogenic index of plasma (AIP), a logarithmically transformed ratio of triglyceride (TG) to high-density lipoprotein-cholesterol (HDL-C) in molar concentration. AIP is a good predictor of the risk of atherosclerosis and coronary heart disease. The AIP is related to the size of anti-atherosclerotic lipoprotein particles, which was a sign of lipid metabolism disorder. Furthermore, AIP can provide information on the severity of insulin resistance, which is associated with impaired glucose metabolism. At present, the researches on AIP at home and abroad mainly focused on diabetic macroangiopathy but there is very less literature on the relationship between AIP and microvascular complications in patients with T2DM.[6]

Thus, this study mainly discusses the correlation AIP with MAU which can predict the occurrence of coronary vascular risk in newly diagnosed T2DM patients.

Objectives

- To look for presence of Dyslipidemia and abnormal Atherogenic index in recently diagnosed type 2 diabetes patients in our hospitals.
- To determine the levels of Microalbuminuria in patients with recently diagnosed Type 2 Diabetes Mellitus in our Hospital.
- To determine whether these patients are at risk for cardiovascular disease by correlating the degree of microalbuminuria with their lipid profile and ratios. (ATHEROGENIC INDEX)

2. Material and methods

2.1. Source of data

Newly diagnosed type 2 Diabetes Patients admitted in the medicine ward and those patients attending the medicine Outpatient department of AL AMEEN MEDICAL COLLEGE AND HOSPITAL, VIJAYAPUR, were chosen as cases. A total of 250 cases that satisfied the inclusion and exclusion criteria were included in the study over a period of 18 months.

- **Study period:** September 2022 to March 2024.
- **Sampling method**: All the newly diagnosed diabetic patients visiting to the hospital satisfying inclusion and exclusion criteria.

2.2. Definitions used in the study

2.2.1. Anthropometric measurements

- **Body Mass Index (BMI):** BMI is defined as the weight in kilograms divided by the height in meters, squared. BMI is increased by muscle mass and does not discriminate between lean body mass and fat mass. Normal BMI should be around 18.5 - 24.9 kg/m2.

2.2.2. Sample collection

- Under aseptic precautions, venous blood samples were drawn from all the subjects, after ensuring an overnight fast of about 12 hours. Postprandial blood samples and early morning urine samples were collected from the selected patients. The blood samples were allowed to clot for 30 minutes and were centrifuged at 3000g for 10 minutes.

The following parameters were estimated after separation of the serum.

- Blood Glucose – fasting and postprandial.
- Fasting lipid profile: - Total cholesterol - HDL cholesterol - Triacylglycerol.
- Serum Creatinine.

2.2.3. Estimation Of Microalbuminuria:

- **Method:** Urine Microalbumin was by measured by Turbidimetric Immunoassay method. In the early morning collected urine sample, Microalbumin was measured.

2.2.4. Atherogenic Index Of Plasma (Aip)

$$AIP = \log (TGL / HDL)$$

2.2.5. Inclusion Criteria

- Age >18 years
- Newly diagnosed T2DM, according to ADA CRITERIA
- Written informed consent
- Gender: patients of both sexes were included.

2.2.6. Exclusion Criteria

- Urinary tract infection
- Macro albuminuria [Proteinuria]
- Renal failure
- Hypolipidemic drugs
- GDM
- Heart failure of any stage.

2.3. Sample size and estimation

Sample size : 250 Cases.

With anticipated correlation between micro albuminuria and Atherogenic index in newly diagnosed Type II Diabetic patients r=0.30 [7], sample size of 250 with 95% confidence Interval and with >95% power.

2.4. Statistical tests

- The data obtained was entered in a Microsoft Excel sheet, and statistical analysis were performed using statistical package for the social sciences (Version 20).
- Descriptive analysis were performed using Mean SD, Median and Inter quartile range, frequency, percentages and diagrams.
- Correlation between Micro albuminuria and Atherogenic index were found using Pearson's / Spearman's correlation.
- P value less than 0.05 were considered statistically significant. All statistical tests were performed two tailed

3. Results and discussion

Table 1 Age Distribution

	GROUP	Mean	Std. Deviation	Mean diff	T value	P value
AGE	GROUP A	52.38	12.642	-0.163	-0.113	0.91
	GROUP B	52.54	9.764			

Test used- independent t test, p>0.05 insignificant

INFERENCE: Mean ±SD of group A and group B was 52.38±12.642 and 52.54±9.764. Results were found to be insignificant on comparing age with group A and group B.

Table 2 Comparison Of Biochemical Characteristics (Aip) In Group A And Group B

PARAMETERS	GROUP	Mean	Std. Deviation	Mean diff	T value	P value
AIP	GROUP A	0.4026	0.06527	-0.19881	-15.828	<0.001***
	GROUP B	0.6014	0.10584			

Test used- independent t test, p<0.001*** highly significant

INFERENCE: Mean ±SD of AIP in group A and group B was 0.4026±0.06527 and 0.6014±0.10584. Results were found to be highly significant on comparing AIP with group A and group B. it was clear in graph AIP was more in group B.

Table 3 Comparison Of Biochemical Characteristics (M. Albumin) In Group A And Group B

PARAMETERS	GROUP	Mean	Std. Deviation	Mean diff	T value	P value
M ALBUM	GROUP A	17.944	5.4420	-63.6968	-9.482	<0.001***
	GROUP B	81.640	61.7519			

Test used- independent t test, p<0.001*** highly significant

INFERENCE: Mean ±SD of M. albuminuria in group A and group B was 17.944±5.4420 and 81.640±61.7519. Results were found to be highly significant on comparing M.albuminuria with group A and group B. it was clear in graph m.albuminuria was more in group B.

Table 4 Determine Correlation Between Antrogenic Indices (AIP) And Microalbuminuria (Group B)

Correlation		Microalbuminuria
Antrogenic indices	Pearson Correlation	0.70**
	Sig. (2-tailed)	0.000

INFERENCE: When comparing antrogenic indices and microalbuminuria, positive correlation (®=0.70**) were present and results were found to be highly significant.

4. Discussion

Micro albuminuria (MA) is defined as persistent elevation of albumin in the urine, of 30–300 mg/day (20–200 µg/min). These values are less than the values detected by routine urine dipstick testing, which does not become positive until protein excretion exceeds 300–500 mg/day. Use of the albumin- to-creatinine ratio is recommended as the preferred screening strategy for all diabetic patients.

The Type 2 diabetes is a major risk factor for cardiovascular disease (CVD). The risk of CV mortality in patients with type 2 diabetes (T2DM) is 2-4 times that observed in individuals without diabetes. CVD accounts for about 70% death

casualty of patients with T2DM. Early assessment and control of CV risk factors in patients with T2DM has a positive effect on reducing the risk of CVD and death in patients and improving the prognosis of patients.

AIP is considered to be a good predictor of atherosclerosis and a highly sensitive predictor of risk for CVD. AIP values show substantial agreement with the results of coronary angiography and are used to predict acute coronary events and prognosis in patients with acute myocardial infarction. AIP is superior to other traditional assessment indexes (e.g., cardiogenic risk ratio and atherogenic coefficient) in assessing risk for CV events. AIP is also considered to predict risk for T2DM.

Thus, based on this the present study has been conducted in the dept of medicine at AL-AMEEN MEDICAL COLLEGE, VIJAYAPURA, with the study period of September 2022 to march 2024 and the sample size was 250 cases. All type 2 DM satisfying inclusion and exclusion criteria were included in the study and, we categorized patients in 2 groups- Group A include patients with diabetes with no micro albuminuria and Group B include diabetes patients with micro albuminuria.

4.1. Age and gender distribution

In this study, (table 1, fig 1) shows Mean ±SD of group A and group B was 52.38±12.642 and 52.54±9.764. Results were found to be insignificant and (table 2, fig 2) Males were 36(42.4%) and maximum females were 49(57.6%) in group A. Males were 75(45.5%) and maximum females were 90(54.5%) in group B. Results were found to be insignificant on comparing gender.

4.2. Comparison of biochemical characteristics in group A and group B

4.2.1. BMI

Mean ±SD of BMI in group A and group B was 26.220±1.7667 and 29.204±1.9599. Results were found to be highly significant on comparing BMI with group A and group B. BMI was more in group B.

4.2.2. FBS

Mean ±SD of FBS in group A and group B was 101.67±17.160 and 118.35±15.402. Results were found to be highly significant on comparing FBS with group A and group B. it was clear in graph FBS was more in group B.

4.2.3. PPBS

Mean ±SD of PPBS in group A and group B was 224.76±82.980 and 275.41±86.043. Results were found to be highly significant on comparing PPBS with group A and group B. it was clear in graph PPBS was more in group B.

4.2.4. CHOLESTEROL

Mean ±SD of cholesterol in group A and group B was 184.59±34.806 and 199.02±35.532. Results were found to be highly significant on comparing cholesterol with group A and group B. it was clear in graph cholesterol was more in group B.

4.2.5. TGL

Mean ±SD of TGL in group A and group B was 99.19±16.788 and 139.88±33.855. Results were found to be highly significant on comparing TGL with group A and group B. it was clear in graph TGL was more in group B.

4.2.6. VLDL

Mean ±SD of VLDL in group A and group B was 20.073±3.3907 and 28.346±5.8257. Results were found to be highly significant on comparing VLDL with group A and group B. it was clear in graph VLDL was more in group B.

4.2.7. HDL

Mean ±SD of HDL in group A and group B was 38.68±2.274 and 35.04±4.897. Results were found to be highly significant on comparing HDL with group A and group B. it was clear in graph HDL was more in group A.

4.2.8. LDL

Mean ±SD of LDL in group A and group B was 125.829±34.0514 and 138.185±25.6297. Results were found to be highly significant on comparing LDL with group A and group B. it was clear in graph LDL was more in group B.

4.2.9. TGL/HDL

Mean ±SD of TGL/HDL in group A and group B was 2.549±.4029 and 4.092±1.0569. Results were found to be highly significant on comparing TGL/HDL with group A and group B. it was clear in graph TGL/HDL was more in group B.

4.2.10. AIP

Mean ±SD of AIP in group A and group B was 0.4026±0.06527 and 0.6014±0.10584. Results were found to be highly significant on comparing AIP with group A and group B. it was clear in graph AIP was more in group B.

In the present study, we found that BMI, FBS, PPBS, cholesterol, TGL, VLDL, LDL, AIP were significantly more in group B. HDL was more in group A. Thus, in the present study these factors indicates AIP is strongly associated with BMI, FBS, PPBS, cholesterol, TGL, VLDL, LDL.

According to study done by Zhen Li et al AIP was mainly related to body weight and body fat correlation index (such as BMI, waist circumference, and waist-hip ratio), blood glucose correlation index (FBG, PPBG, and HbA1c), and insulin resistance index (HOMA-IR).[8]

Individuals in the group with higher AIP were at an increased risk for hypertension and atherosclerotic plaques. Logistic multiple regression analysis showed that systolic blood pressure, waist circumference, fasting blood glucose, and HOMA-IR were independent risk factors for AIP. The risk of CV and cerebrovascular diseases in patients with T2DM is increased, and the rate of death from disability is high. Risk factors for more aggregation in patients with T2DM include insulin resistance, central obesity, elevated blood pressure, and elevated total triglycerides. The underlying mechanisms include increased oxidative stress, increased inflammation, or endothelial cell dysfunction in association with low levels of HDL cholesterol. The risk factors associated with increased AIP are closely related to those for CVD and cerebrovascular disease in patients with T2DM. Compared with risk factors associated with CVD and cerebrovascular disease, those associated with increased AIP are more conducive to monitoring and follow-up.

4.3. Comparison of biochemical characteristics: (M. albumin and creatinine) in group A and group B

In this study we found that Mean ±SD of M. albuminuria in group A and group B was 17.944±5.4420 and 81.640±61.7519. Results were found to be highly significant on comparing M. albuminuria with group A and group B. it was clear in graph m. albuminuria was more in group B. and we found positive correlation with AIP and M. albuminuria. Mean ±SD of creatinine in group A and group B was 0.811±1.1456 and 1.035±1.3086. Results were found to be highly significant on comparing creatinine with group A and group B. It was clear in graph creatinine was more in group B.

Study done by Zhen Li et al [8] also found significant association with albuminuria with AIP. In the present study we also found the association with albuminuria with AIP.

The relationship between AIP and MAU has been addressed in previous studies. Previous reports found a significantly positive correlation between AIP and MAU in patients with diabetes, general population in different countries, and postmenopausal women. AIP may also be used to predict hyperuricemia. According to the results presented above, individuals with higher AIP also had higher MAU levels. Furthermore, a significantly positive correlation between AIP and MAU was identified, with MAU as a risk factor for AIP, which was also shown in previous study.

24-hour urinary microalbumin is one of the most sensitive indexes to reflect glomerular damage in the early stage. At present, many studies showed that AIP has a good predictive value for diabetes and the occurrence of diabetes complicated with macroangiopathy. Some studies (Ma X, Sun Y et al,[9] Zhou K et al[10]) also showed that AIP was related to the distribution of body fat in diabetic patients.

The close relationship of MAU to metabolic diseases might be directly related to the effect on endothelial dysfunction, oxidative stress, and inflammation or indirectly related to several metabolic syndrome risk factors. This might be helpful to explain the relationship between AIP and MAU.

The relationship between AIP and diabetic microvascular complications has not previously been fully elucidated. Previous studies have indicated that patients with T2DM and increased AIP are at greater risk for microalbuminuria and that AIP is an early predictor of DM. Socorro Souza e Silva Moura et al.[11] showed that AIP is positively correlated with microalbuminuria in patients with hypertension. Akdoğan et al.[12] showed no difference in AIP between patients with T2DM with retinopathy, compared with patients with T2DM without retinopathy. However, Miric et al. demonstrated that AIP was higher in patients with T2DM with neuropathy, compared to patients with T2DM without

neuropathy. The results presented in this study indicate increased risk for microvascular complications in patients with higher AIP. However, only the difference in prevalence of DN was found to be significant.

Patients with T2DM are susceptible to the disorder of blood lipid metabolism, and excessive lipids are gradually deposited in non-fat tissues and organs such as kidney, liver and blood vessels, which eventually leads to lipotoxicity and aggravates the disease progress. According to the theory of nephrotoxicity, excessive fatty acids and toxic metabolites are deposited in the glomerulus and renal tubules, activating various signal pathways, including oxidative stress, inflammation, fibrosis and apoptosis. These phenomena will lead to renal cell injury and dysfunction, and ultimately accelerating glomerulosclerosis and tubulointerstitial fibrosis.

5. Conclusion

To sum up, our research shows that AIP is an independent risk factor for microalbumin in newly diagnosed T2DM patients, which has a good predictive value for its occurrence. AIP may be used as an index for monitoring patients during follow-up.

At present, blood lipid detection is relatively easy and feasible in the clinic, and it could be used as a reference index of abnormal lipid metabolism. In the aspect of the economy, AIP is simple and easy to calculate, which is not only an index of lipid metabolism disorder, but also could predict early renal function damage in T2DM patients, which is worthy of clinical popularization and usage.

More over microalbuminuria is itself a predictor of CVD and in association with AIP its predicting accuracy for CVD further increases. Hence all physicians should look for early possibility of microalbumiuria and deranged AIP in newly diagnosed diabetic patients so that these patients can be treated promptly and can be prevented from dreaded complications of diabetes.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Eastman RC, Kenn H. The impact of cardiovascular disease on people with diabetes: the potencial for prevention. Lancet 1997; 350(suppl I): 29-32.

[2] Niskanen L, Uusitupa M, Sarlund H, et al. Microalbuminuria predicts the development of serum lipoprotein abnormalities favouring atherogenesis in newly diagnosed type 2 diabetic patients. Diabetologia 1990; 33: 237-43.

[3] Stephenson JM, Kenny S, Stevens LK, Fuller JH, Lee E, and the WHO Multinational Study Group. Proteinuria and Mortality in Diabetes: the WHO Multinational Study of Vascular Disease in Diabetes. Diabetic Med 1995; 12: 149-55.

[4] Deckert T, Feldt-Rasmussen B, Borsch-Johnsenk K, et al. Albuminuria reflects widespread vascular damage. The steno hypothesis. Diabetologia 1989; 32: 219-26.

[5] Yudkin JS. Microalbuminuria: a genetic link between diabetes and cardiovascular disease? Ann Med, 1992; 24: 517-22.

[6] Dobiasova M, Raslova K, Rauchova H, et al. Atherogenic lipoprotein profile in families with and without history of early myocardial infarction. Physiol Res. 2001;50(1):1–8.

[7] Dr. Premjeet Kaur, "Evaluation of Association between Microalbuminuria and Serum Lipid Profile in Type 2 Diabetes Mellitus", International Journal of Science and Research (ISR), Volume 8 Issue 5, May 2019, pp. 517-519.

[8] Li Z, Huang Q, Sun L, Bao T, Dai Z. Atherogenic index in type 2 diabetes and its relationship with chronic microvascular complications. International journal of endocrinology. 2018;2018(1):1765835.

[9] Ma X, Sun Y, Cheng Y, et al. Prognostic impact of the atherogenic index of plasma in type 2 diabetes mellitus patients with acute coronary syndrome undergoing percutaneous coronary intervention. Lipids Health Dis. 2020;19(1):240. doi:10.1186/s12944-020 01418-0

[10] Zhou K, Qin Z, Tian J, et al. The atherogenic index of plasma: a powerful and reliable predictor for coronary artery disease in patients with type 2 diabetes. Angiology. 2021;72(10):934–941. doi:10.1177/00033197211012129

[11] R. do Socorro Souza e Silva Moura, D. F. Vasconcelos, E. Freitas, F. J. D. de Moura, T. T. Rosa, and J. P. R. Veiga, "Cystatin C, CRP, Log TG/HDLc and metabolic syndrome are associated with microalbuminuria in hypertension," Arquivos Brasileiros de Cardiologia, vol. 102, no. 1, pp. 54–59, 2014.

[12] M. Akdoğan, Y. Ustundag-Budak, and K. Huysal, "The association of hematologic inflammatory markers with atherogenic index in type 2 diabetic retinopathy patients," Clinical Ophthalmology, vol. 10, pp. 1797–1801, 2016