



# Assessment Of Ischemia-Modified Albumin As A Marker Of Glycemic Status In Type 2 Diabetes Mellitus Patients

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## Abstract

### Background:

Ischemia-modified albumin (IMA) is a novel biomarker of ischemia and oxidative stress. Several studies have demonstrated elevated IMA levels in diabetes mellitus (DM). Type 2 diabetes mellitus (T2DM) is a metabolic disorder characterized by hyperglycemia, dyslipidemia, and increased oxidative stress, predisposing patients to cardiovascular complications. The present study aimed to estimate serum IMA levels in patients with T2DM and evaluate its correlation with glycemic status and lipid profile parameters.

### Materials and Methods:

A total of 200 subjects were recruited from the Medicine Outpatient Department of INDEX Medical College and Hospital. Among them, 100 patients were diagnosed with T2DM according to ADA 2016 guidelines, and 100 age- and sex-matched healthy individuals served as controls. Fasting blood sugar (FBS), postprandial blood sugar (PPBS), HbA1c, lipid profile, malondialdehyde (MDA), reduced glutathione (GSH), and serum IMA were measured. Statistical analysis was performed using Student's *t*-test and Pearson's correlation test.

### Results:

Patients with T2DM exhibited significantly higher levels of FBS, PPBS, HbA1c, total cholesterol, triglycerides, LDL-cholesterol, MDA, and IMA, along with significantly lower HDL-cholesterol and GSH levels compared to controls ( $p < 0.05$ ). Serum IMA showed a significant positive correlation with FBS, PPBS, HbA1c, total cholesterol, triglycerides, and LDL-cholesterol, while a negative correlation was observed with HDL-cholesterol.

## Conclusion:

Serum IMA levels are significantly elevated in patients with T2DM and are strongly associated with poor glycemic control and dyslipidemia. IMA may serve as an early biomarker for ischemia and cardiovascular risk in patients with type 2 diabetes mellitus, aiding in better disease management and prognosis.

**Keywords:** Type 2 diabetes mellitus, ischemia-modified albumin, hyperglycemia, dyslipidemia, oxidative stress

## Introduction

Type 2 diabetes mellitus (T2DM) is a chronic metabolic disorder characterized by persistent hyperglycemia resulting from insulin resistance and relative insulin deficiency. The global prevalence of diabetes is increasing rapidly, particularly among younger populations, leading to a significant burden of cardiovascular morbidity and mortality. Chronic hyperglycemia induces oxidative stress, endothelial dysfunction, and vascular inflammation, thereby accelerating both microvascular and macrovascular complications.

Ischemia-modified albumin (IMA) has emerged as a sensitive biomarker of ischemia and oxidative stress. Ischemic conditions induce structural modifications at the N-terminal region of human serum albumin, reducing its ability to bind cobalt ions and forming IMA. Elevated levels of IMA have been reported in various pathological conditions, including myocardial ischemia, renal failure, malignancies, and diabetes mellitus.

In diabetes, increased production of reactive oxygen species (ROS) due to hyperglycemia alters albumin structure and promotes lipid peroxidation. Dyslipidemia, commonly observed in T2DM, further aggravates oxidative stress and endothelial damage, increasing the risk of atherosclerosis and cardiovascular events.

Given the strong association between oxidative stress, dyslipidemia, and ischemia in T2DM, this study was designed to evaluate serum IMA levels in patients with type 2 diabetes mellitus and assess its correlation with glycemic indices and lipid profile parameters. Identification of such associations may help in early detection of ischemic risk and prevention of cardiovascular complications in diabetic patients.

## Materials and Methods

### Study Design and Participants

This hospital-based case-control study was conducted in the Department of Biochemistry, INDEX Medical College and Hospital, Indore, in collaboration with the Department of Medicine, from July 2021 to August 2022. A total of 200 participants were enrolled in the study and categorized into two groups. Group I consisted of 100 patients diagnosed with type 2 diabetes mellitus (T2DM) according to the American Diabetes Association (ADA) 2016 diagnostic criteria. Group II included 100 age- and sex-matched apparently healthy individuals who served as controls.

### Inclusion Criteria

Patients diagnosed with type 2 diabetes mellitus, aged between 30 and 60 years, and willing to provide written informed consent were included in the study.

### Exclusion Criteria

Subjects with acute or chronic infections, hepatic or renal disorders, a history of ischemic episodes, pregnancy, or those receiving corticosteroid therapy were excluded from the study.

## Biochemical Analysis

Venous blood samples were collected from all participants after an overnight fast under aseptic conditions. Fasting blood sugar (FBS), postprandial blood sugar (PPBS), glycated hemoglobin (HbA1c), and lipid profile parameters were estimated using standard biochemical methods. Serum malondialdehyde (MDA), reduced glutathione (GSH), and ischemia-modified albumin (IMA) levels were also measured. Serum IMA was estimated using the albumin cobalt-binding assay.

## Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 22 (SPSS Inc., Chicago, IL, USA). Results were expressed as mean  $\pm$  standard deviation (SD). Comparison between groups was performed using Student's *t*-test, and Pearson's correlation coefficient was used to assess the relationship between variables. A *p*-value less than 0.05 was considered statistically significant.

## Results

- T2DM patients showed significantly higher glycemic indices and dyslipidemia compared to controls.
- Serum IMA levels were markedly elevated in diabetic patients.
- IMA showed a significant positive correlation with FBS, PPBS, HbA1c, total cholesterol, triglycerides, and LDL-cholesterol.
- A negative correlation was observed between IMA and HDL-cholesterol.

## Discussion

The findings of the present study indicate that serum IMA levels are significantly elevated in patients with type 2 diabetes mellitus, reflecting increased oxidative stress and ischemic burden. Poor glycemic control and dyslipidemia contribute to endothelial dysfunction and enhanced production of reactive oxygen species, resulting in increased IMA formation. These findings are consistent with previous studies reporting elevated IMA levels in diabetic patients with or without cardiovascular complications.

The significant correlation between IMA and lipid parameters further emphasizes its role as a potential marker of cardiovascular risk in T2DM. Early detection of increased IMA levels may help in timely intervention to prevent ischemic complications.

## Conclusion

Serum ischemia-modified albumin is significantly elevated in patients with type 2 diabetes mellitus and correlates strongly with glycemic control and lipid abnormalities. IMA may serve as a valuable early biomarker for ischemia and cardiovascular risk in diabetic patients, contributing to improved disease management and prognosis.

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