

Estimation of Serum Sialic Acid in the Patients of Type-2 Diabetes Mellitus

SOFIA CHANDIO¹, NAZISH SHAFI², MARIA ASIF³, FAHAD AMAN KHAN⁴, SINDHU LAGHARI⁵, ALI RAZA MEMON⁶

¹Lecturer, Department of Biochemistry, Liaquat University of Medical and Health Sciences, Jamshoro

²Senior Registrar, Department of Medicine, Al Aleem Medical College, Lahore

³Lecturer, Department of Biochemistry, Liaquat University of Medical and Health Sciences, Jamshoro

⁴Associate Professor, Department of Medicine, Al Aleem Medical College, Lahore

⁵Research Associate, Medical Research Center Diabetic Clinic, Liaquat University of Medical and Health Sciences, Jamshoro

⁶Associate Professor, Department of Biochemistry, Liaquat University of Medical and Health Sciences, Jamshoro

Correspondence to: Ali Raza Memon, Email: raza.memon@lumhs.edu.pk, Cell: 0335-2395085

ABSTRACT

Background: Diabetes Mellitus is one of the leading cause of morbidity & mortality all over the world. The poor glycemic control in the patients of type-II diabetes mellitus can lead the development of complications which cause the morbidity in the life of diabetic population. The aim of this study was to estimate the serum sialic acid in the patients of type- II diabetes for early prediction of diabetic complications.

Methodology: This case comparative study was conducted at the Diabetes Clinic of LUMHS Jamshoro with the collaboration of the Department of Biochemistry at LUMHS. A total of 84 diagnosed cases of type-II Diabetes Mellitus were included in this study. In group A, 40 diabetes mellitus cases were diagnosed with a history of diabetes less than five years, while in group B 44 had histories of diabetes over ten years. Spectrophotometers were used to measure serum sialic acid levels using Ehrlich's reagent. SPSS version 22 was used for data analysis with independent student t tests applied.

Results: The mean serum sialic acid level of group A was 56.42 ± 5.67 mg/dl, while serum sialic acid level of group B was 69.88 ± 7.34 mg/dl. There was significant ($p < 0.05$) increased level of serum sialic acid in the type-II diabetic patients of group B, which indicate there is more chance to development of micro vascular complications in type-II diabetic patients with prolong duration for their diseases period.

Conclusion: Estimation of serum sialic acid in the patients of type-II diabetes mellitus is one of the early predictive marker for the complications of diabetes mellitus.

Keywords: Type-II Diabetes Mellitus, Serum Sialic Acid, Estimation, HBA1C

INTRODUCTION

The term diabetes mellitus refers to the disorder of carbohydrate, protein and lipid metabolism that is caused by a variety of etiologies.¹ There will be a reduction in the synthesis or secretion of insulin hormone, which can lead to hyperglycemia and other symptoms of diabetes mellitus.² There are more than 230 million people worldwide suffering from diabetes mellitus, with more than 350 million people expected to suffer from diabetes by 2025.³

90% of the diabetic population suffers from type-II diabetes, which is the most prevalent type of diabetes.⁴ As a result of poor hypoglycemic control, the heart, kidney, eyes, brain, and neurons can be highly affected and then considered micro- or macrovascular complications of diabetes mellitus.^{5,6}

Basically, sialic acid is a type of acetylated N-uraminic Acid that belongs to the acetylated family.⁷ As a cofactor, sialic acid is mainly active during acute stages of inflammation or injury, and it acts primarily on cell receptors as a cofactor.^{8,9} In the cell membrane, glycoproteins and glycol lipids, which form sialic acid, make up a significant portion of the structure.¹⁰ Endothelial and vascular permeability of sialic acid is controlled by the molecular composition of sialic acid.¹¹

During vascular injury, sialic acid will peel from the cellular membrane and vascular membrane, resulting in microvascular damage.¹² Endothelial cells easily permeate sialic acid during microvascular inflammation or injury, which causes its concentration to rise.¹³ In diabetic patients with elevated sialic acid levels, microvascular injury may occur in the kidney, retina, heart, or brain.^{14,15}

Our objective in this study is to estimate serum sialic acid in patients diagnosed with Type II diabetes mellitus in order to rule out the possibility of microvascular complications in these patients.

METHODOLOGY

The study was conducted at the Diabetic Clinic Medicine Department of LUMHS Jamshoro; Sindh from August 2021 to October 2021 in collaboration with the Department of Biochemistry of LUMHS Jamshoro; Sindh. There were 84 diagnosed cases of type-II diabetes mellitus recruited for this research and subdivided into two groups. The group A had 40 diagnosed cases of type-II diabetes mellitus with a history of diabetes under five years, while

the group B had 44 diagnosed cases of type-II diabetes mellitus with a history of diabetes of more than ten years. A long-term diagnosis of type-II diabetes mellitus is associated with a high risk of diabetic complications.

Sampling was done using a non-probability method. Patients with type-II diabetes mellitus aged 40 - 70 years, males and females, with HbA1c% under 9.0%, non-hypertensive, were included. We excluded cases of type-I diabetes mellitus with age less than 40 years or more than 70 years, with HbA1c% level greater than 9.0%, with history of insulin therapy, hypertension, cardiovascular problems such as myocardial infarction or bypass surgery, dyslipidemia, renal disorders, neuropathy, vision problems, liver disorders, cases of type-I diabetes mellitus, any carcinoma, history of smoking, alcohol and women pregnant during this research.

Informed consent was obtained from each patient before collecting 6-7 cc of fasting (8-12 hours) blood samples from antecubital vein and dispersing 3cc in EDTA tube for estimating HbA1c% and 3-4 cc in plain tube for measuring fasting blood glucose level and serum sialic acid level. Glucose oxidase was used to measure fasting blood glucose levels. The HbA1c% levels were determined by Bio Red Variant Analyzer whereas serum sialic acid levels were determined by Spectrophotometer using Ehrlich's reagent.¹⁶

In order to compare the serum sialic acid levels between the two groups, we used SPSS version 22 and applied a student dependent t test to analyze the data.

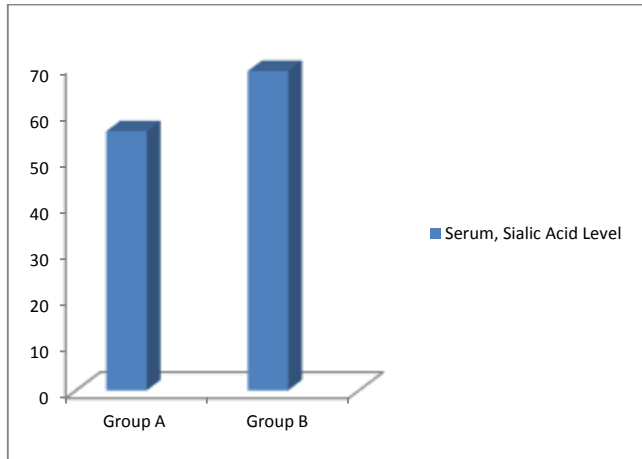
RESULTS

Total 84 cases were selected and divided in to two groups; group-A as control group while group B as case study group. The mean fasting blood sugar level of group A was 146.35 ± 13.79 mg/dl, while group B was 152.92 ± 12 mg/dl. The mean HbA1c% of group A was 8.3%, while mean HbA1c% of group B was 8.5%. The mean serum sialic acid level of group A was 56.42 ± 5.67 mg/dl, while serum sialic acid level of group B was 69.88 ± 7.34 mg/dl. The serum sialic acid levels were significantly higher ($p < 0.05$) in the type-II diabetic patients of group B than in the type-I diabetic patients of group A, which indicates that type-II diabetic patients

with prolonged durations of their diseases are more likely to develop microvascular complications as a result of their diseases.

Table 1: Parameters Under study in Both Groups of Diabetic Patients

Parameter	Group A (Control)	Group B (Case Study Group)	P.Value
FBS (mg/dl)	146.35 ± 13.79	152.92 ± 12	0.03
HbA1c%	8.3%	8.5%	0.012
Serum Sialic Acid (mg/dl)	56.42 ± 5.67	69.88 ± 7.34*	< 0.05*



Graph 1: Serum Sialic Acid in Both Groups of Diabetic Patients

DISCUSSION

There is no doubt that diabetes mellitus is the leading cause of mortality and morbidity in the whole world, and it is the leading cause of morbidity in Pakistan as well.¹⁷ Diabetes mellitus is the disturbance of carbohydrate metabolism which lead insulin insufficiency or deficiency of insulin.¹Sialic acid basically belongs to acetylated family of nuraminic acid.⁷

In acute phases of inflammation or injury, sialic acid acts as a cofactor on cell receptors to assist in the healing process.⁸ Sialic acid is primarily made up of glycoproteins and glycol lipids found at the membrane of cells.⁹ In the acute phase of a reaction, sialic acid is considered a biomarker.¹⁸ The negative charge on renal basement membrane also controlled by sialic acid, so sialic acid consider as one of main regulator of membrane permeability.^{19,20} Approximately 50% of the free sialic acid in serum is provided by acute phase proteins, while the bound form is cleared by the renal system along with creatinine, resulting in minor reabsorption and maximum filtration at the glomerulus.^{21,22}

Diabetes mellitus also triggers acute reactions and innate immunity, so sialic acid may be a predictor marker.²³ In diabetes mellitus, ovarian cancer, arthritis, CNS disorder level of free circulating sialic acid becomes increased.^{24,25} The presence of sialic acid at cell receptors, like insulin receptors, plays a crucial role in the development of type-II diabetes.²⁶ Additionally, sialic acid levels are elevated more profoundly in diabetic complications.

During this study, the aim was to assess the serum sialic acid level in patients suffering from type-II diabetes mellitus with short and long durations of the disease, and significant increases in level were observed if the period of diabetes lasted longer. The results of our study are strongly supported by Shilpa A et al², who propose that serum sialic acid level increases in diabetic nephropathy, suggesting that diabetic complications need more time to develop, so our study makes the serum sialic acid level a good indicator of early detection of diabetic complications before they progress.

A study published by El Syed MS et al (2018)²⁷ also reported that the serum sialic acid level is significantly increased in patients

with diabetic retinopathy. We also found that this research supported the findings of our study as well.

Our study had some limitations, such as a limited sample size owing to the high incidence of type-II diabetes mellitus. These samples were all collected from the same diabetic center, but they had to collect samples from different areas of the region in future. It will be necessary to work out large sample sizes and to evaluate the effect of serum sialic acid on different macrovascular and microvascular complications of type-II diabetes.

CONCLUSION

The study concluded that the estimation of serum sialic acid in the patients of type-II diabetes mellitus serves as a major early predictive marker of the complications of diabetes mellitus, when compared to other risk factors for the disease.

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