Original Research Article

Evaluation of sialic acid levels in type-2 diabetes mellitus patients in NCR, Delhi

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ABSTRACT

Background: Diabetes mellitus is one of the most common metabolic disorders characterized by chronic hyperglycemia, and it is associated with increased prevalence of microvascular complications. Serum sialic acid has developed as a potential risk factor for Type-2 Diabetes Mellitus. In type-2 diabetic individuals, elevated serum sialic acid is often observed as compared to non-diabetic individuals.

Materials and Methods: The study conducted in NCR, Delhi was a cross-sectional analysis on 70 participants between the age group of 30 to 70 years. This included two groups of thirty-five individuals with type-2 diabetes mellitus recruited as cases (15 males and 20 females) and thirty-five individuals without diabetes taken as controls (16 males and 19 females). Fasting blood glucose and serum sialic acid in the both groups were measured.

Results: In the present study, serum sialic acid levels were shown to be increased in type-2 diabetes mellitus (76.60±7.89) compared to non-diabetics (39.66±9.55) with a statistically significant p-value of < 0.001.

Conclusion: On the basis of present study, it is concluded that the serum sialic acid levels were found to be increased in type-2 diabetic patients of Delhi -NCR which reflect that these patients were at the risk of developing microvascular complications. Therefore, estimating sialic acid levels may aid in early diagnosis and prevention of microvascular complications caused by type-2 diabetes mellitus.

1. Introduction

Diabetes Mellitus is a lifelong progressive disease and is one of the groups of metabolic disorders which is characterized by elevation of blood glucose levels, producing hyperglycemia.[1] It mainly occurs due to increase in the insulin resistance and β-cell dysfunction.[2] Its leads to the long-term dysfunction of various organs such as heart, kidneys, eyes, nerves, and blood vessels[3] which cause several microvascular complications such as cardiovascular disease, nephropathy, retinopathy, neuropathy and other debilitating conditions. Type-2 diabetes mellitus has become very common throughout the world during the last few decades. More than 16 million Americans in the United States have type-2 diabetes mellitus, while diabetics in India were found to be 40.6 million in 2006, expected to increase to 79.4 million by 2030.[4] It has been suggested that increasing blood glucose levels encourage the inflammatory process that leads to diabetes development and its microvascular complication.[5] Sialic acid, also known as N-acetyl neuraminic acid, is one of the inflammatory markers of an acute phase reaction, and an important component of glycoproteins and glycolipids.[6] It is found to have positive linkage to most acute phase reactants. Sialic acid can also be used to measure an acute phase reaction as many of the glycoproteins have sialic acid on their oligosaccharide chain's terminal part.[7] Patients with type-2 diabetes mellitus may have high serum sialic

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acid concentrations and evidence is also available that this may be associated to the extent of their microvascular complications.[8] An increased serum sialic acid level may also serve as a strong predictor of human cardiovascular death.[3] Studies done in South India have suggested that the concentration of serum sialic acid in type-2 diabetes mellitus is increased[9] but as per the best of our knowledge, there is no documentation for any study done in National Capital Region, Delhi. Hence, our study aimed to evaluate the association of serum sialic acid with blood glucose levels in diabetics and non-diabetics in the NCR, Delhi region.

2. Materials and Methods

This study was carried out in 2019 on 70 individuals between the age group of 30-70 years. The study group consisted of 35 individuals who were type-2 diabetic (15 males and 20 females) and 35 individuals who were not diabetic (16 males and 19 females). This research work has been accepted by the institute's ethical committee. The sample sizes were determined by college statisticians basing on administrative challenges and costs in mind.[10]

2.1. Inclusion criteria

All newly diagnosed or already diagnosed patients of diabetes mellitus taking oral hypoglycemic medication were recruited in this study. According to the American Diabetes Association (ADA) diagnostic criteria, a fasting blood glucose level of 126 mg/dl or higher was taken.[11]

2.2. Exclusion criteria

Excluded from this study were patients of type-2 diabetes mellitus with association of acute and chronic inflammatory disorders, hypertension, pregnancy, HIV / AIDS drug patients, and thyroid disorders.

2.3. Blood collection, separation, storage and analysis of sample

Following overnight fasting, 2 ml of venous blood sample was collected in a plain vacutainer using all aseptic precautions to estimate serum sialic acid, and 1 ml of blood sample was collected in fluoride vacutainer to estimate fasting blood glucose. The plain vacutainer was centrifuged for 15 minutes at 3000 rpm to separate the serum, and the serum was stored at -20°C until sialic acid was estimated. Fasting blood glucose was estimated by GOD-POD method using VITROS 5600 (fully Automated Biochemistry Analyzer). The % CV of this method is 1.3%.

Serum sialic acid was measured by Ehrlich's method according to the method reported by Sydow G, et al. in 1988.[12] 400 μl of serum was mixed with 1.2 ml of 5% perchloric acid for 5-10 min at 100°C and centrifuged at 2000 rpm for 5 min. The supernatant (400μl) was mixed with 400μl of Ehrlich reagent (5gm of p-dimethylaminobenzaldehyde /50ml of HCl /50 ml of distilled water). After incubation at 100°C for 15 min, a spectrophotometer was used to read the optical density at 525 nm.

2.4. Statistically analysis

Independent sample t-test was used to see the mean difference between the two groups for measurement scale data. The p-value of less than 0.05 is considered as significant at 95% confidence level. The p-value below 0.001 is regarded as highly significant. The statistical software SPSS version 24.0 was used in the analysis.

3. Results

The results of various investigation conducted on two study groups are shown in Table 1 and Table 2. The results are compared between case and control groups.

3.1. Fasting blood glucose

The fasting blood glucose in case group and control group are shown in Table 1. A highly significant difference is observed in case group as compared to the control group with higher values found in case group. There is a 92.39 per cent increase in the case group as compared to the control group.

3.2. Serum sialic acid

The Serum Sialic Acid in case group and control group are shown in Table 1. Highly significant difference is found in group of cases when compared to group of control with higher values found in group of Cases. In Case group, there is an increase of 93.14 per cent compared to control group.
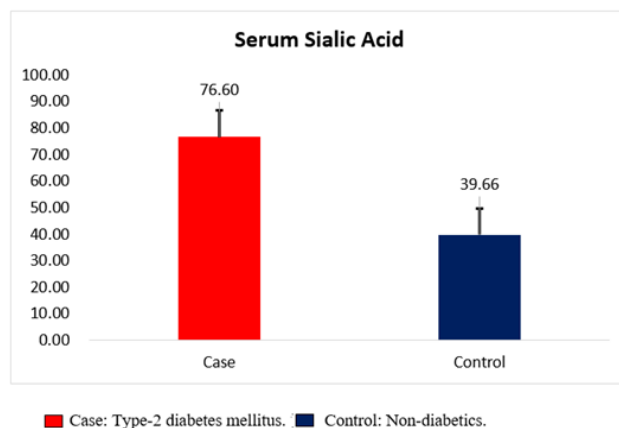

Fig. 1: The mean level of Serum Sialic acid in Case and Control groups.

Table 1: Comparision of mean Fasting Blood Glucose and Serum Sialic acid values between the Case and Control groups

Parameter	Group	N	Mean	SD	t-value	p-value
Fasting Blood Glucose (mg/dl)	Case	35	174.77	30.12	15.625	<0.001
	Control	35	90.97	9.98		
Serum Sialic Acid (mg/dl)	Case	35	76.6	7.89	17.644	<0.001
	Control	35	39.66	9.55		

p-value < 0.001 Highly significant , p-value < 0.05 Significant & p-value < 0.1 Non-significant

Table 2: Correlation between Fasting Blood Glucose and Serum Sialic Acid in Case group

Correlation		Fasting Blood Glucose	Serum Sialic Acid
Fasting Blood Glucose (mg/dl)	Pearson Correlation	1	0.941**
	Sig. (2-tailed)		<0.001
Serum Sialic Acid (mg/dl)	Pearson Correlation	0.941**	1
	Sig. (2-tailed)	<0.001	

**. Correlation is significant at < 0.001 level (2-tailed)

3.3. Correlation of fasting blood glucose and serum sialic acid in case group

The correlation between fasting blood glucose and serum sialic acid in case group are shown in Table 2. The case group data were analyzed by Pearson correlation and showed statistically significant positive correlation of serum sialic acid and blood glucose level.

4. Discussion

Diabetes mellitus is one of the world's biggest health problem including in India. Much attention has recently been paid to the relation between inflammation and type-2 diabetes mellitus. The present study was conducted in order to assess the relationship between fasting blood glucose and serum sialic acid levels in non-diabetics as compared to type-2 diabetes mellitus. We observed that serum sialic acid levels were increased in type-2 diabetes mellitus (76.60±7.89) compared to non-diabetics (39.66±9.55) with a statistically significant p-value of < 0.001.

Results of this present study suggest that the inflammation is involved in type-2 diabetes mellitus pathogenesis. Inflammation could be an early indicator of type-2 mellitus diabetes. Also, elevated serum sialic acid concentration in type-2 diabetes was observed in various studies. The vascular permeability is controlled by Sialic acid as it is a part of the cell membrane. The amount of sialic acid in the vascular endothelium is found to be high and therefore the microvascular damage caused by type-2 diabetes mellitus contributes to the release of sialic acid into the bloodstream and to an overall increase in sialic acid concentration.[9,13] Elevation of blood levels could promote the inflammation by increased oxidative stress. Increase in the insulin resistance and hyperglycemia also promote inflammation which may be a factor linking the diabetes to the development of atherosclerosis.[14]

Indeed, many of the studies have shown that if tissue damage, tissue proliferation, and tissue inflammation occur, serum sialic acid concentration is increased in pathological conditions. Damage to the tissue caused by the diabetes mellitus vascular complications causes cytokine release from cellular infiltration. It activates an acute phase response which leads to the discharge of an acute phase glycoprotein from the liver with sialic acid into the bloodstream resulting in increased concentrations of serum sialic acid.[15]

In the present study done in National Capital Region (NCR), Delhi region, Serum sialic acid concentration increases with increase in blood glucose concentration in type-2 diabetes patients, which is concomitant with the other studies. Therefore, Serum sialic acid could be considered as an early marker of type-2 diabetes mellitus.

5. Conclusion

On the basis of present study, it is concluded that the serum sialic acid levels were found to be increased in type-2 diabetic patients of Delhi -NCR which reflect that these patients were at the risk of developing microvascular complications. Therefore, estimating sialic acid levels may aid in early diagnosis and prevention of microvascular complications caused by type-2 diabetes mellitus.

6. Limitations of the Study

This was a cross-sectional study limited to specific area, therefore longitudinal study needs to be conducted on larger geographical area for more reliable conclusion.

7. Acknowledgments

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8. Source of Funding

None.

9. Conflicts of Interest

None.

References

1. Burtis CA, Ashwood ER, Bruns DE. Carbohydrates. Teitz textbook of Fundamentals of Clinical Chemistry. 6th ed. New Delhi; 2008.
2. Ferrier DR. Diabetes Mellitus. Lippincott textbook of Biochemistry. 7th ed. New Delhi; 2017.
3. Mahendran KB, Kumari RD, Babu MF, Kumar NS. Evaluation of Sialic acid Levels in Patients with Type 2 Diabetes Mellitus. *IOSR J Dent Med Sci*. 2013;5(1):33–6.
4. Saghir AJ, Khaleeq UR, Nazia I, Abu BI, Muhammad Q, Shazia Z. Evaluation of serum sialic acid and other risk factors in diabetes mellitus. *Afr J Biotechnol*. 2017;16(50):2326–30.
5. Ghosh J, Datta S, Pal M. Role of sialic acid in prediction of diabetic nephropathy. *AI Ameen J Med Sci*. 2016;9(1):58–64.
6. Nayak SB, Bhaktha G. Relationship between Sialic acid and metabolic variables in Indian type 2 diabetic patients. *Lipids Health Dis*. 2005;4(15):1–4.
7. Pickup JC. Inflammation and Activated Innate Immunity in the Pathogenesis of Type 2 Diabetes. *Diabetes Care*. 2004;27(3):813–23.
8. Ismail M, Bakeer SA, Aziz H, Ma M, Fahmy IA. Role of Elevated Serum Sialic Acid in the Progression of both Diabetic Retinopathy and Diabetic Nephropathy. *JMSCR*. 2015;3(11):8422–31.
9. Kp, Kumar JA, Rai S, Shetty SK, Rai T, Shrinidhi. Predictive Value of Serum Sialic Acid in Type-2 Diabetes Mellitus and Its Complication (Nephropathy). *J Clin Diagn Res*. 2013;7(11):2435–7.
10. Bhalerao S, Kadam P. Sample size calculation. *Int J Ayurveda Res*. 2010;1(1):55–7.
11. American Diabetes Association. Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes care. 2019;42:13–28.
12. Sydow G, Wittmann W, Bender E, Starick E. The sialic acid content of the serum of cattle infected with bovine leukosis virus. *Arch Exp Veterinarmed*. 1988;42(2):194–7.
13. Prakash S, Sudha S. Relationship between nitric oxide and sialic acid concentrations in south Indian type 2 diabetic patients. *Adv Appl Sci Res*. 2013;4(3):258–62.
14. Baynes JW, Thorpe SR. Role of oxidative stress in diabetic complications: a new perspective on an old paradigm. *Diabetes*. 1999;48(1):1–9.
15. Crook MA, Pickup JC, Lumb PJ, Georgino F, Webb DJ, Fuller JH. Relationship Between Plasma Sialic Acid Concentration and Microvascular and Macrovascular Complications in Type 1 Diabetes: The EURODIAB Complications Study. *Diabetes Care*. 2001;24(2):316–22.

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