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Original Research Article

A Hospital-Based Evaluation of the Relationship between Serum Ferritin Levels and Glycemic Management in Individuals with type 2 Diabetes Mellitus

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Abstract

Aim: To investigate the relationship between serum ferritin levels and glycemic management in individuals with type 2 diabetes mellitus.

Materials and Methods: The research was carried out at the Cardiology department of IGIMS in Patna, Bihar, India from March 2018 to February 2019. This study included 50 type 2 diabetics and 50 healthy controls. The diagnosis was made by clinical examination and biochemical tests. All participants gave informed consent. The human ethics committee approved the project. The effects of body iron reserves on biochemical markers in diabetics were examined using standard methods: serum ferritin (SF), fasting, postprandial blood glucose, glycosylated Hb. In data analysis, unpaired t-tests were used to compare all values between control and study groups, and Pearson correlation tests were used to correlate ferritin with other parameters.

Results: The mean ± SD age in the study group was 49.58 ± 8.82 years, whereas the control group had 46.98 ± 8.977 years. In the research group, men outnumbered women 1.08:1. Cases had substantially higher levels of FBS, PP2BS, HbA1c, and Ferritin ($p<0.0001$) compared to controls. Serum ferritin levels have positive correlations with FBS ($r=0.600$, $p<0.0001$), PP2BS ($r=0.526$, $p<0.0001$), and HbA1c ($r=0.701$, $p<0.0001$).

Conclusion: Our data imply that iron excess, as seen by elevated SF levels, may contribute to type 2 diabetes. In accordance with earlier research, serum ferritin should be included in regular screening protocols to identify people at risk of type 2 DM and to check glycemic control in those who have the condition.

Key Words: Fasting blood glucose, HbA1c, Serum ferritin, Type 2 diabetes mellitus.

Introduction

Type 2 Diabetes Mellitus (T2DM) is a long-term metabolic illness that is characterised by the body's reduced response to insulin, decreased production of insulin, and consistently high levels of glucose in the blood. T2DM is becoming more common worldwide, which presents major public health issues since it is linked to many consequences such as cardiovascular illnesses, nephropathy, retinopathy, and neuropathy. Controlling blood glucose levels is essential for minimising the likelihood of these problems. Serum ferritin has attracted interest among the several biomarkers researched in connection to glycemic management, because of its probable involvement in the development and advancement of type 2 diabetes mellitus (T2DM). Serum ferritin serves as an indicator of iron storage inside the body and is often used to evaluate one's iron levels. Patients with type 2 diabetes mellitus (T2DM) often exhibit increased levels of ferritin in their blood, and there is a growing body of research indicating a connection between ferritin levels and the regulation of blood sugar. Hyperferritinemia in individuals with type 2 diabetes mellitus (T2DM) is thought to be linked to insulin resistance, inflammation, and oxidative stress, which are important contributors in the development of diabetes. [1,2] Iron is essential for several physiological activities, such as the transportation of oxygen, the creation of DNA, and the transfer of electrons in mitochondria. Excessive amounts of iron may accelerate the generation of reactive oxygen species (ROS) via the Fenton reaction, resulting in oxidative stress and harm to cells. Oxidative stress has been linked to the emergence of insulin resistance and β-cell dysfunction, both of which play a crucial role in the development of type 2 diabetes mellitus (T2DM). [3] The relationship between serum ferritin and

glycemic management is intricate and influenced by several factors. An possible mechanism is the function of iron in facilitating insulin resistance. Excessive accumulation of iron has been shown to hinder the pathways that allow insulin to function properly, resulting in reduced absorption of glucose by tissues outside of the main organs and increased synthesis of glucose by the liver. This leads to increased blood glucose levels and inadequate glycemic control. [4] There is a strong connection between serum ferritin and glycemic management, and inflammation plays a crucial role in this relationship. Ferritin is a biomarker that is elevated during periods of inflammation as part of the body's acute-phase response. T2DM is characterised by chronic inflammation, which is strongly linked to insulin resistance and β-cell dysfunction. High levels of ferritin in the blood may indicate an ongoing inflammatory process that is causing difficulties in controlling blood sugar levels. [5,6] Oxidative stress is also involved in the connection between serum ferritin levels and glycemic management. An excess amount of iron may accelerate the process of reactive oxygen species (ROS) generation, resulting in oxidative harm to pancreatic β-cells and peripheral organs. Oxidative stress hampers the ability of the body to produce and use insulin, making hyperglycemia worse and leading to inadequate control of blood sugar levels.

Materials and Methods

The research was carried out at the Cardiology department of IGIMS in Patna, Bihar, India from March 2018 to February 2019. The research was structured as a case-control study. The current research examined 50 individuals with confirmed type 2 diabetes mellitus and 50 individuals who were considered to be in good health as a control group. The patients were largely diagnosed by clinical examination and then assessed through biochemical studies. Obtained informed consent from all subjects. The research underwent assessment and received approval from the human ethics committee.

In order to determine the impact of body iron reserves on several biochemical parameters, diabetics were subjected to the following examinations: measurement of Serum Ferritin (SF) levels, fasting and postprandial blood glucose levels, and assessment of glycosylated Hb levels using established techniques. The data analysis included doing an unpaired t-test to compare all values between the control and study groups. Additionally, the association between ferritin and other parameters was examined using the Pearson correlation test.

Results

The current research found that the average age in the study group was 49.58 ± 8.82 years, whereas in the control group it was 46.98 ± 8.977 years. The research group had a male-to-female ratio of 1.08:1. Table 1 displays the comparison of FBS (fasting blood sugar), PP2BS (postprandial 2-hour blood sugar), HbA1c (glycated haemoglobin), and ferritin levels between the study group and the control group. According to the data in Table 1, the levels of FBS, PP2BS, HbA1c, and Ferritin are substantially higher ($p<0.0001$) in the cases compared to the controls. Table 2 demonstrates a significant correlation between serum ferritin levels and the values of FBS ($r=0.600$, $p<0.0001$), PP2BS ($r=0.526$, $p<0.0001$), and HbA1c ($r=0.701$, $p<0.0001$).

Table 1: Comparison of biochemical parameters between study & control group.

Parameter	Study	Control	Significance
	Mean ± SD	Mean ± SD	
FBS	218.5 ± 96.15	87.88 ± 5.989	**p<0.0001
PP2BS	260.0 ± 95.37	105.5 ± 9.83	**p<0.0001
HbA1c	8.308 ± 1.971	4.272 ± 0.3839	**p<0.0001
Ferritin	319.7 ± 133.6	67.40 ± 30.53	**p<0.0001

Table 2: Correlation of serum ferritin with other biochemical parameters in study group.

Ferritin compared to other parameter		p value	Pearson coefficient (r)
Name of parameter	Mean value		
FBS	218.5 ± 96.15	p<0.00001	0.600
PP2BS	260.0 ± 95.37	p<0.0001	0.526
HbA1c	8.154 ± 2.00	p<0.0001	0.701

Discussion

The study clearly demonstrates that higher levels of body iron stores, as indicated by SF levels, are significantly and directly correlated with FBS, PP2BS, and HbA1c. There is an emerging worry regarding the association between iron reserves and type 2 diabetes with evidence that modestly high body iron stores below levels frequently reported in hereditary hemochromatosis may be related with poor health effects. Prospective studies have shown that elevated serum ferritin levels independently

predict the development of type 2 diabetes in apparently healthy men and women. [6] Ferritin is a complex of iron, phosphorus, and protein that serves as a biomarker for assessing the levels of iron in the body. Elevated iron concentrations lead to tissue and organ damage. [7] Elevated iron levels disrupt insulin production and release from the pancreas, as well as impair the liver's ability to extract insulin. Muscle damage caused by iron deposition reduces the ability of muscles to take up glucose. In contrast, insulin promotes the absorption of iron by cells by increasing the externalisation of the transferring receptor. Insulin and iron can enhance each other's effects, resulting in a harmful cycle that leads to insulin resistance and diabetes. [8] In the current investigation, ferritin levels were considerably higher in patients with type 2 DM (319.7 ± 133.6 vs. 67.40 ± 30.53 ng/ml, $p<0.0001$) as compared to controls (Table 1) which were similar with the studies published by F. Sharifi and colleagues. They determined that the ferritin (101 ± 73 mg/ml vs. 43.5 ± 42 mg/ml, $p<0.001$) were considerably greater in patients with type 2 diabetes as compared to control subjects. [9] Our findings align with those of Rui Jiang, who observed that the average concentration of Ferritin was significantly higher in the study group of type 2 DM cases compared to the control subjects. [10] It's obvious from the research that ferritin levels were strongly connected with FBS, PP2BS and HbA1c. Similar study conducted by Sumeet Smotra et al. [11] and Jeevan K. Shetty et al. [12] found increased levels of Serum Ferritin and also reported that diabetics with increased level of Serum Ferritin had significantly poor glycaemic control reflected by higher levels of HbA1c as compared to diabetes cases under good glycaemic control and healthy controls. Positive connection between FBS and HbA1c as well as ferritin and HBA1c shows hyperglycemia producing increased glycation of hemoglobin and increased release of free iron from glycated proteins like hemoglobin. This causes a vicious cycle of hyperglycemia, glycation of hemoglobin and rise in levels of free iron and ferritin. This increasing presence of iron pool would accelerate oxidant production resulting damage to biomolecules. [12]

Conclusion

Our research indicates that an excess of iron, as shown by elevated levels of serum ferritin (SF), may play a significant role in the onset of type 2 diabetes. Hence, in accordance with prior research, we propose the incorporation of serum ferritin into the usual screening strategy for identifying individuals at risk of acquiring type 2 DM, as well as for evaluating glycemic control in those who have already been diagnosed with the condition.

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