Serum Iron Profile in Type 2 Diabetes Mellitus

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Abstract

Background:
Type 2 diabetes Mellitus is a major growing health issue worldwide. There is a strong relation between iron parameters and type 2 diabetes mellitus. Iron metabolism can directly or indirectly affect the occurrence and development of type 2 diabetes.

Objectives:
To observe serum levels in Type 2 Diabetes Mellitus patients.

Methods:
This cross sectional study was conducted from to in the Department of Physiology, Rangpur Medical College, Rangpur. For this study, total number of 150 subjects were selected among them 75 non-diabetic healthy subjects were included in group-A and 75 Type 2 Diabetes Mellitus patients were included in group-B. The subjects of group-A were selected from surrounding community of Rangpur district and subjects of Group-B were selected from Diabetic Association and from Outdoor of Endocrinology Department, Rangpur Medical College and Hospital, Rangpur. For statistical analysis independent sample "t"test was performed by computer based software SPSS- 23.0 version for windows.

Results:
Mean serum free iron concentration in Group A and Group B were 12.29±3.1 µmol/l and 15.24±6.8 respectively. Mean TIBC in Group A and Group B were 68.06±7.3 µmol/l and 56.89 ± 8.6 respectively. Mean serum ferritin concentration were 131±12.90 mg/ml and 170.50±15.1 respectively. The difference between serum iron, TIBC and ferritin between Group A and Group B were highly significant ($p \le 001$).

Conclusion:
The results obtained from this study suggests that serum iron and serum ferritin were increased and TIBC was decreased in T2DM patients as compared to healthy control.

Keywords: Serum iron, TIBC, ferritin, T2DM patients

Introduction:

Diabetes mellitus, a most common chronic metabolic disorder, characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both, affecting millions of people worldwide.[1] Diabetes mellitus (DM) is the most prevalent chronic non-communicable disease all over the world. It is frequently preventable. This disease is responsible for millions of deaths annually.[2] Diabetes is undoubtedly one of the most challenging health problems in the 21st century.[3] The global rise in the number of individuals affected by diabetes is a significant and alarming health issue. More than 80% of diabetes-related deaths occur in middle and low-income countries.[4] Projections suggest that by the year 2030, approximately 79.[4] million individuals worldwide will be living with diabetes. Furthermore, the World Health Organization (WHO) predicts that by 2030, diabetes will become the seventh leading cause of death globally.[5] Mineral elements play a crucial role not only in providing structural support to body tissues but also in being actively involved in various metabolic pathways.[6]

The essential trace element iron (Fe) and related parameters such as serum ferritin, serum transferrin, and total iron binding capacity (TIBC) are

considered to have a significant association with glucose metabolism as well. There is a growing concern regarding the connection between iron stores and the severity of Type 2 diabetes. Research has indicated that excessive iron levels in the body are associated with the presence of diabetes as well as metabolic syndrome. This suggests that elevated body iron may contribute to the development and progression of Type 2 diabetes and metabolic syndrome.[7,8]

Studies have shown that individuals with diabetes mellitus (DM) are at a higher risk of developing anaemia compared to those without diabetes, particularly in developing countries. The prevalence of anaemia among patients with DM is approximately twice as high as in individuals without DM.[9]

The purpose of our study is to emphasize the impact of iron metabolism on impaired glucose regulation and determine whether parameters related to iron metabolism can serve as predictors of T2DM. This study will help to assess the prevalence of thyroid disorder among Type 2 Diabetes Mellitus patients and thereby develop awareness about thyroid dysfunction in Type 2 diabetes mellitus. So this study will be helpful for the early detection of any abnormalities in iron profiles in Type 2 Diabetes Mellitus which will help patients improve their health, proper management and reduce their morbidity rate.

Objective:
The objective of this study is to evaluate the levels of serum iron, total iron binding capacity (TIBC), ferritin in Type 2 diabetes.

Materials and Methods:
This Cross-sectional analytical study was conducted at the Department of Physiology, Rangpur Medical College, Rangpur from January 2023 to July 2023. The Rangpur Medical college ethical committee and thesis protocol review committee approved the study protocol. For this study, A total number of 150 subjects of both sexes with age 30–45 years were divided into the following groups: Group A- 75 non-diabetic healthy subjects and Group B- 75 Type 2 Diabetes Mellitus patients. The subjects of group A were selected from the surrounding community of Rangpur district. The subjects of Group B were selected from the Diabetic Association and from the Outdoor of Endocrinology Department, Rangpur Medical College and Hospi-

tal, Rangpur. All the subjects were free from a history of liver, heart, lung, and other chronic systemic diseases, obesity, hypertension, pregnancy, and lactating mothers. After the selection of subjects, the objectives, and the procedure of the study were explained, written consent was taken. A standard questionnaire was filled out after taking history and thorough clinical examinations. On the first day, all the study procedures were maintained, and advised the subjects were to be in an overnight (8-10 hrs) fasting state. A fasting venous blood sample was collected from the antecubital vein from each subject under all aseptic precautions by a disposable syringe on the next day at 8.00 AM. at the Department of Physiology, Rangpur Medical College, Rangpur. The test tube containing blood was kept in a standing position till the formation of a clot. Serum was separated by centrifuging the blood at 3000 rpm for 5 minutes. The clear supernatant was taken and kept in ependroffs. All biochemical tests were carried out as early as possible and done by enzymatic colorimetric method at the Department of Biochemistry, Rangpur Medical College, Rangpur. For statistical analysis independent sample "t'' test was performed by computer-based software SPSS- 23.0 version for Windows.

Results:
The mean ± SD of serum free iron were 12.29±3.1 µmol/l in Group A and 15.24±6.8 µmol/l in group B. The mean ± SD of serum ferritin concentration were 131.29±12.90 mg/ml in Group A and 170.50±15.1 mg/ml in Group B. Mean ± SD of TIBC was 68.06±7.3 µmol/l in Group A and 56.89±8.6 in Group B. (Table-I)

Table-I: Serum Iron, TIBC and Ferritin levels in between the groups

Variables	Group		p-value
	Group A (Mean±SD)	Group B (Mean±SD)	
Serum Iron (µmol/l)	12.29±3.1	15.24±6.8	0.003**
TIBC (µmol/l)	68.06±7.3	56.18 ± 8.6	0.026*
Serum Ferritin (mg/ml)	131±12.90	170.50±15.1	0.022*

Discussion:
Scientific research indicates that there are intricate connections between the metabolism of iron and Type 2 diabetes. Iron status has been found to impact glucose metabolism, and conversely, glucose metabolism affects various iron metabolic

pathways. This relationship between iron and glucose metabolism is bidirectional. Additionally, oxidative stress and inflammatory cytokines play a role in influencing and intensifying these interconnected processes.[10]

In T2DM, increased blood glucose changes the blood osmolality, which may cause hemolysis and can interfere with hemoglobin and iron metabolism. Emerging scientific evidence also suggested that iron status can influence glucose metabolism and can lead to insulin resistance in diabetic patients.[11] Elevated iron stores may induce diabetes through a variety of mechanisms, including oxidative damage to pancreatic beta cells, impairment of hepatic insulin extraction by the liver and interference with insulin's ability to suppress hepatic glucose production.[12]

Increased serum ferritin is often associated with measures of insulin resistance, such as elevated blood glucose and insulin levels. On the other hand, it is increasingly being recognized by a few researchers that serum iron influences glucose metabolism even in the absence of significant iron overload or even in a state of iron deficiency.[13] Iron is a transitional metal and a potential catalyst in cellular reactions that produces oxygen-reactive species such as hydroxyl radical (OH-) and superoxide anion (O-) that can initiate and propagate the cascade leading to oxidative stress and finally cell death.[14] In DM, there is a decrease in the update of iron and an increase circulatory pool of catalytic iron. In DM, increased blood glucose stimulates the non-enzymatic glycosylation of several proteins including hemoglobin. Glycosylation of hemoglobin also leads to an increase in iron release from protein.[15]

Increased levels of iron in the body can potentially lead to the development of diabetes through various mechanisms. These mechanisms include causing oxidative damage to pancreatic beta cells, impairing the liver's ability to extract insulin, and interfering with insulin's ability to suppress glucose production in the liver.[16]

Glycation of haemoglobin contributes to a substantial affinity for transitional metals, and glycation of haemoglobin decreases the ability to transfer to bind ferrous iron. When concentrations of antioxidants are low, reducing potential and anaerobiosis progressively increase, facilitating a rapid release of iron from ferritin.[17] The ferroxidase

activity of the heavy chain in apoferritin is also downregulated in this setting resulting in an increase in free iron as pro oxidant agent. reactive oxygen species have been shown to interfere with insulin signaling at the cellular level. Hydroxyl radical is generated and causes damage to cellular membrane-potentiated nucleic acid. These events lead to insulin resistance and finally type 2 diabetes mellitus.[18] At least three possible explanations may account for elevated ferritin levels in patients with diabetes. First, high ferritin concentration may represent elevated iron body stores. Second, ferritin as an acute-phase reactant may reflect inflammation. Third, delayed clearance of glycosylated ferritin in patients with diabetes may lead to elevated ferritin concentrations.[19]

Conclusion:

Estimation of iron profile will be useful in diabetes mellitus patients and the risk of development of diabetic complications by reactive oxygen species, and associated inflammatory disorders, all of which in turn will help in the overall management of diabetic patients.

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