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ORIGINAL ARTICLE

Diabetes Mellitus Type 2 Associated Alterations in the Regulation of Blood Sugar, Kidney Function and Oxidative Stress

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ABSTRACT

Background: Diabetes mellitus (T2DM) is a multifactorial disease that produces high blood sugar levels.
Duration of study: February 2019 to April 2021
Place of study: Arif Memorial Hospital , Galwera village, Kasur road Lahore
Method & Result: 50 Pakistani T2DM individuals were investigated. Insulin, insulin resistance (IR), and insulin sensitivity were the glycemic control measures (IS). Renal function tests looked at urea and creatinine. TAC and ROS were oxidative stress indicators (ROS). T2DM patients exhibited greater fasting blood glucose, HbA1c, insulin, and IR than non-T2DM controls. Pseudo-insulin sensitivity reduced in patients (p<.01). Urea and creatinine levels climbed somewhat in T2DM patients. TAC increased in patients over controls (P<.05). Less than 2% of T2DM patients had elevated ROS (P<.02). TAC and fasting blood glucose exhibit a positive (P<.02) relationship. Fasting blood glucose and IS have a substantial negative relationship (P0.01). HbA1C correlates with IR, creatinine, and TAC but not with ROS (P<.01). HbA1C and IS had a strong (P0.01) negative relationship. Diabetes mellitus is associated with insulin resistance (IR). Significant IS, creatinine, and ROS interactions (P<.01). IS and urea are antithetical (P<.05). Urea and creatinine have a strong (P<.01) connection. TAC is anti-ROS (P<.05).
Conclusion: Glycemic instability in diabetic's More than persistent hyperglycemia, blood glucose fluctuations may cause oxidative damage. The strong positive connection between fasting blood glucose and the other investigated measures shows that hyperglycemia is an independent risk factor for T2DM development.
Keywords: Glycemic control, fasting blood glucose, urea, creatinine, total antioxidant capacity, reactive oxygen species.

INTRODUCTION

Aberrant hyperglycemia is a difficult situation in diabetes. T2DM is becoming more common. One in every five Pakistanis has T2DM. Routine diabetic screening begins at 45 and is repeated every three years for individuals at risk. Two-hour postprandial glucose of 200 mg/dL or above after 75 g oral glucose consumption is measured type 2 diabetes. The HbA1c indicates the three-month average blood glucose. RER in beta-cells makes insulin. Getting rid of insulin requires insulin receptors and an enzyme. Insufficient amounts of these two molecules contribute to insulin resistance and poor insulin purification. An increase in blood insulin and glucose levels happens when target tissues lose their insulin sensitivity.

Chronic kidney disease develops from untreated T2DM nephropathy, worsening T2DM treatment. Uncontrolled T2DM elevates urea and creatinine, which corresponds with kidney damage. The kidney excretes urea, a nitrogen waste carrier. In the body, creatinine is a steady breakdown product.

It is defined as an imbalance between ROS production and clearance. Increased free radical production or diminished antioxidant mechanisms appear to increase it. Oxidative stress likely causes peripheral IR and other long-term T2DM issues. As a result of excessive diet and inactivity, the mitochondrial electron transport chain produces excessive ROS. Fluctuating blood sugar levels may be as harmful as chronic hyperglycemia. Despite the fact that various T2DM medications have been approved in the last decade, many people still suffer. Medication adherence and reduced physical exercise are all factors. Less glucose-lowering drugs work better when the underlying pathophysiological process and sickness phase are worse.

MATERIALS AND METHODS

A total of 50 T2DM patients (82 males and 18 women) were studied. Controls were 20 healthy adults. Everyone was told to fast for 10–12 hours before giving blood.

Preparation of blood samples: EDTA tubes with fasting venous blood were collected from all subjects. This study used disposable gel tubes to collect blood, which was subsequently centrifuged at 3500 g for 10 minutes. TAC and ROS were measured at room temperature serum.

RESULTS

The research population's glycemic control parameters: Fasting blood sugar, HbA1C, insulin, IR, and IS are shown in Table 1. FBS control mean value(79.42±12.02) against Patients mean value (199.75±49.02). Also, HbA1c levels rose in T2DM patients (7.14±1.09%) compared to controls (p<0.01) (4.09±0.68 %). insulin and IR levels increased considerably (P <0.01) for insulin 18.01±4.31 in patients and its control 6.99±1.98.74 IU/ml). For IR 7.87±3.01 in patients and its control 1.882±0.59. T2DM patients' insulin sensitivity (0.28±04) for control its (0.42±0.03).The high fasting blood glucose level in T2DM patients was expected. This finding echoes others. Hypoinsulinemia (fasting glucose > 180 mg/dL) and reduced peripheral IR are hallmarks of T2DM. T2DM patients had a greater HbA1C than healthy controls.

Table 1: Glycemic control characteristics at various levels in T2DM patients and controls

Parameters	Mean ± SD		P value
	Patients	Control	
FBG(mg/dl)	199.75±49.02	79.42 ±12.02	0.001
HbA1C (%)	7.14±1.09	4.09±0.68	0.001
Insulin (µIU/ml)	18.01±4.31	6.99±1.98	0.008
Insulin resistance	7.87±3.01	1.882±0.59	0.001
Insulin sensitivity	0.30±0.03	0.42±0.03	0.0011

Level of Renal function tests and oxidative stress parameters: Urea and creatinine levels were used to assess renal function in the study group (Table 2). Both urea and creatinine levels were found to be significantly higher in T2DM patients than in healthy controls (5.93±2.01and79.99±14.78 , respectively). Several studies have connected urea to creatinine. T2DM patients reported slightly higher urea and creatinine levels than healthy controls. The current study's findings support earlier findings that T2DM patients had higher urea and creatinine levels (P<0.05). A small sample size, technological issues, demographic inequities in health care and

genetic vulnerability to illness may explain the study's lacklustre results.

Table 2Level of Renal function tests and oxidative stress parameters

Parameter	Mean ± SD		P value
	Patients	Control	
Urea (mmol/l)	5.93±2.01	4.67±1.77	0.104
Creatinine (mmol/l)	79.99±14.78	67.7±9.22	0.243
TAC (mmol/l)	2399.88±600.01	2156.67±199.49	0.030
ROS (mmol/l)	182.83±39.48	24.86±3.02	0.001

The HbA1c is a useful glycemic control test for T2DM patients. Others observed a significant rise in HbA1c.Hyperglycemia raises insulin levels, which in turn raises insulin synthesis by 50folds. Hyperinsulinaemia enhances free radical production via NADPH-dependent mechanisms. The current study's findings support past research linking T2DM patients' insulin levels to IR status. Pancreatic cells try to compensate for muscle cell insulin requirements, resulting to insulin resistance and T2DM. A cell malfunction is also possible. The current study backs up Mohsen's results of increased insulin, IR, and fasting blood glucose. Insulin resistance causes mild PPH. Insufficient pancreatic beta-cell activity leads to relative insulin insufficiency, fasting hyperglycemia, and T2DM. T2DM patients showed lower IS than controls. Diabetes and insulin resistance can impede IS. Butler et al. claim that T2DM has weak IS and causes beta-cell death. Unwanted glucocorticoids cause IS impairment by increasing amino acid concentrations and inhibiting insulin pathways. Several studies, including Mohsen's, found low IS in T2DM patients.

It depends on insulin secretion, insulin sensitivity, and free fatty acid concentrations . The new statistics confirm a previous study's findings. In T2DM patients, elevated HbA1C indicates poor blood glucose control due to increased glucose binding to tissue proteins, including haemoglobin. The positive relationship between FASTING blood glucose and IR was multi-causal. A high blood sugar produces IR by inhibiting insulin-induced tyrosine autophosphorylation. Chronic high glucose exposure can harm beta cells. Thus, chronic hyperglycemia may exacerbate IR. The current study confirms prior findings between fasting blood glucose with IR in obese T2DM patients. Cells reduce insulin sensitivity, leading in hyperglycemia. An increase in hepatic glucose production and a decrease in skeletal muscle and adipose tissue glucose absorption are observed in T2DM individuals with lower IS. Hyperglycemia and insulin resistance are connected. Diabetic nephropathy is caused by uncontrolled blood glucose levels. This confirms previous study linking hyperglycemia to renal damage. Urine and creatinine levels should be examined in T2DM patients. There is a significant positive relationship between Urea and fasting and postprandial Blood Glucose. Furthermore, fasting blood glucose and creatinine levels were revealed to be positively related in T2DM.

There is a strong positive correlation between TAC and ROS. Excessive hyperglycemia increases ROS production and oxidative stress in islet cells. Increased TAC protects against ROS. TAC levels are higher in T2DM patients. Using HbA1C can assist patients avoid daily glucose fluctuations and fasting. In T2DM patients, greater HbA1c levels associated favourably with IR and adversely with IS. This shows that creatinine increased with HbA1c. While HbA1C had a weak negative link with urea, previous studies showed it had high positive and negative correlations with creatine and urea, respectively. In some cases, carboxylated Hb might interfere with HbA1c testing. The current investigation found a positive correlation between HbA1C, TAC, and ROS. Other studies found the same. However, rising TAC levels in T2DM patients appear to be a sign of tolerance to rising ROS. Also, some T2DM patients change their health habits and take antioxidants like vitamins. Also, insulin levels associated with IR but not IS. Hyperinsulinemia and IR are important components of T2DM, and their presence increases morbidity and mortality. Other research has identified a link between insulin and IR.Its findings coincide with another study that indicated both hyperglycemia and hyperinsulinemia impair IS.The current study's findings demonstrate a substantial negative link between IR and IS and a positive correlation with ROS.Given that IR patients' target tissues are less sensitive to insulin, the negative connection between IR and IS makes logical.An earlier study related IR, ROS, and T2DM. For more information about insulin resistance, go here. Low insulin levels cause insulin resistance in fat, liver, and muscle cells. Previous research revealed the same. Like previous observations, TAC levels showed an inverse relationship with ROS.

CONCLUSIONS

The patient's blood glucose level is dangerously low. Insulin resistance is caused by a high consumption of glucose from the diet along with inactivity. This boosts the production of ROS. Changes in blood glucose levels, just as persistent hyperglycemia, can result in oxidative damage in the body. The examined factors and fasting blood glucose levels were shown to be highly linked (HbA1C, IR, urea, creatinine, TAC, and ROS). Hyperglycemia is unquestionably a risk factor for the development of type 2 diabetes.

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