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Fructose, Glucose and Uric Acid Levels in Sera of Iraqi Women with Diabetes Mellitus

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ABSTRACT

To identify the true contribution of diabetes mellitus disease on the levels of some endogenous chemical substances like fructose, glucose and uric acid, we tested 31 women with independent diabetes mellitus between the age range of 18-35 years. The study included another 18 normal women in the same age range, conducted in Baghdad, Capital of Iraq, from January to June 2002. All women were examined for alteration of substances levels; the results showed 35.1% significant increase of fructose level than normal ($p < 0.00001$). Also tested were glucose and uric acid levels, which were 47.7% and 40.2% significant increase, respectively, than normal subjects ($p < 0.00001$). Furthermore, we noticed a non-significant moderate negative correlation between fructose and glucose in these patients ($r = -0.438$), and a strong positive correlation between fructose and uric acid for the same group ($r = 0.735$). The results indicate that the contribution of diabetes mellitus disease to the levels of chemical substances like fructose, glucose and uric acid in Baghdad women is greatly overestimated.

Keywords: Diabetes mellitus, fructose, glucose, uric acid.

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INTRODUCTION

Diabetes is becoming the third 'killer' of mankind, after cancer and cardiovascular diseases, because of its high prevalence, morbidity and mortality [1]. It has been reported that alterations occur in the various glycoproteins in human diabetes [2]. Raised concentration levels of glycoproteins in diabetics may also be an indicator of angiopathic complications [3]. Glycoproteins play a major role in the pathogenesis of diabetes mellitus due to impaired metabolism [4]. Glycoproteins are a group of complex proteins containing covalently bound oligosaccharides attached to their polypeptide backbone. Hexose, fructose, hexosamines and sialic acid form the monosaccharide units of oligosaccharide [5]. Fructose [6-deoxy-L-galactose] is a monosaccharide that is found on glycoproteins and glycolipids in vertebrates, invertebrates, plants and bacteria [6]. Fructose is one of the eight essential sugars that the body requires for optimal function of cell-to-cell communication. The L form is the only common form of the sugar, while the D form is a synthetic galactose analogue. Fructose should not be confused with fructose, which is a monosaccharide found in fruits and honey [7]. Many epidemiological studies has shown that serum uric acid is an end product of purine metabolism, and is associated with an increased risk of hypertension [8,9,10], cardiovascular disease [9, 11], and chronic kidney disease [12]. However, the association between serum uric acid levels and diabetes mellitus is not clear [13].

Several studies have concluded that fructose metabolism is abnormal in people with cystic fibrosis, diabetes, and during episodes of shingles, which is caused by a herpes virus [8]. The aim of this study was to investigate changes in the level of serum fructose, glucose and uric acid in diabetic patients compared to control subject.

MATERIALS AND METHODS

Patients

Samples were collected from women patients treated in Al-Yarmook Teaching Hospital from January to June 2002. Thirty one patients with independent type of diabetes mellitus and 18 normal healthy subjects in the age range of 18-35, were included in this study. None of the control group had history of renal, hepatic and cardiac diseases.

Biochemical measurements

Fructose levels were determined in serum by method of Dische and Shattles [14], glucose and uric acid was done using Biomerieux–laboratories kits.

Statistical analysis

Statistical analysis was done by SPSS statistical software version 10.00. Values were expressed as means \pm SD. The level of significance was determined by student's t-test. When

the P value was equal to or less than 0.05, the difference between the two groups was considered statistically significant.

RESULTS

Total number of patients was 49, 31 with diabetes mellitus and 18 normal healthy subjects. Table 1 shows the results of laboratory tests as mean \pm SD.

Table 1: Serum fructose, glucose and uric acid in diabetes mellitus patients and healthy subjects.

Groups	Fructose conc. [mg/dl]	Glucose [mg/dl]	Uric acid [mg/dl]	P value
Control [n = 18]	10.311 \pm 0.565	117.118 \pm 21.837	4.023 \pm 2.025	\leq 0.00001
Diabetes mellitus [n = 31]	15.906 \pm 24.55	224.226 \pm 100.143	7.11 \pm 0.802	

The results indicated that there was a highly significant increase $p \leq 0.05$ in the levels of fructose, glucose and uric acid in patient group compared to healthy subjects. Serum fructose levels in diabetic patients were selected as the principle variable which is correlated with glucose and uric acid. The results in Figures 1 and 2 reveal the correlation coefficient values r and the levels of significance for the corresponding values of serum fructose and the changes in serum glucose and uric acid in patients group.

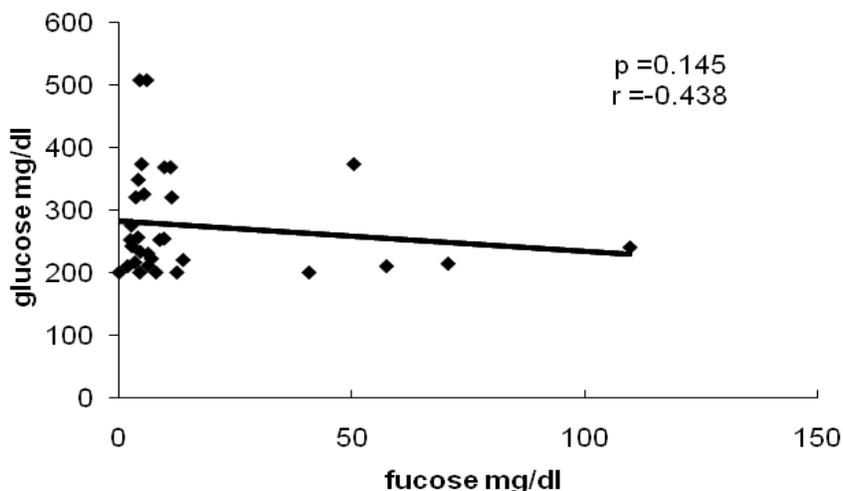


Figure 1: Correlation between serum fructose and glucose in diabetic patients.

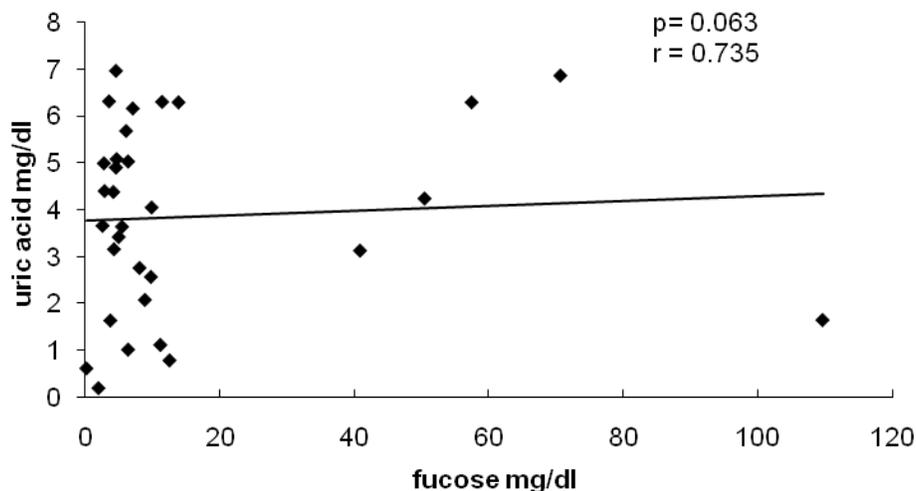


Figure 2: Correlation between serum fructose and uric acid in diabetic patients.

The results indicated that there was non-significant negative correlation [$r = -0.438$, $p = 0.145$] between fructose and glucose, and non-significant positive correlation [$r = 0.735$, $p = 0.063$] between fructose and uric acid in patients groups.

DISCUSSION

Biochemical markers play an important role in accurate diagnosis and also for assessing risk and adopting therapy that improves clinical outcome [15]. The present results showed that the levels of fructose, glucose and uric acid were significantly increased in the sera of patients with diabetes mellitus compared to healthy subjects. An earlier study has shown that in normal circulation, fructose concentration increase as much as eight-fold in diabetes [16]. Yorek et al. [17] found that fructose was significantly increased in serum from a more severely diabetic set of rats, compared with the more moderately diabetic rats. Fructose is a member of a group of essential sugars that the body requires for functioning of cell to cell communication, and its metabolism appears to be altered in various disease conditions such as diabetes mellitus [18]. Increase in fructose levels in diabetic state may be due to increased glycosylation. The serum proteins haptoglobin, α -1 acid glycoprotein and α 1-antitrypsin are synthesized in the liver; metabolism and synthesis of these proteins may be altered in diabetes leading to changes in serum in the hyperglycemia state, which accelerates the synthesis of basement membrane components i.e., glycoproteins [19]. The utilization of glucose was depressed by insulin dependent pathways, thereby enhancing the formation of hexose, hexosamine and fructose for the accumulation of glycoproteins [20].

The association between serum uric acid levels and diabetes mellitus is not clear. Some studies reported that there is a positive association between high serum uric acid levels and diabetes [21-25], whereas other studies reported no association [26], or an inverse relationship [27, 28]. Pavani and Anoop [13] found that higher serum uric acid levels were inversely associated with diabetes mellitus in a representative sample of US adults. Adlija et al. [29] suggest a possible link between uric acid levels and diabetes. Interestingly, serum uric acid

levels were increased in Type 2 diabetic patients and this phenomenon seemed to be more profound in male diabetic patients, who also demonstrated more prominent effect of glucose control on uric acid clearance than their female counterparts. Association between increasing serum uric acid and diabetes mellitus may be related to the inhibition of uric acid reabsorption in the proximal tubule by high glucose levels in diabetic individuals [30, 31].

The results of this study also indicated that there was a non-significant negative correlation [$r = -0.438$, $p = 0.145$] between fructose and glucose, and a non-significant positive correlation [$r = 0.735$, $p = 0.063$] between fructose and uric acid in patients groups. Cook et al. [32] showed that there is a positive relationship between serum glucose and serum uric acid concentrations.

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