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ORIGINAL ARTICLE

Adiponectin serum levels correlate with insulin resistance in type 2 diabetic patients

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Abstract The adipose tissue is not only an inert storage depot for lipids, but also it secretes a variety of bioactive molecules, known as adipokines, which affect whole-body homeostasis. Adiponectin is the most abundant of these adipocytokines and is known to have a regulatory effect on the metabolism of glucose and lipid. The main objectives of this study were to evaluate the serum levels of adiponectin and to establish a correlation between adiponectin serum levels and the degree of insulin resistance in type 2 diabetic patients. Eighty participants were enrolled in this study; 61 type 2 diabetic patients and 19 apparently healthy subjects. Serum level of adiponectin was measured by enzyme-linked immunosorbent assay (ELISA) for each participant. Data collection sheet was filled with all required information for each participant. Adiponectin level in the diabetic patients (5.05 ± 2.61 μg/ml) was lower than in non-diabetic healthy controls (5.71 ± 2.35 μg/ml). When the results were compared according to gender, diabetic females showed significantly higher adiponectin levels (5.76 ± 2.64 μg/ml) than diabetic males (4.366 ± 2.43 μg/ml, $P = 0.035$). In addition, female diabetic patients with abdominal obesity (waist circumference (WC) $\geqslant 88$ cm) had lower adiponectin levels (5.58 ± 2.58 μg/ml) than diabetic females without abdominal obesity (6.96 ± 3.12 μg/ml). The correlation analysis indicated that adiponectin had a significant positive correlation with age ($r = -0.450$, $P < 0.001$). In conclusion, female diabetic patients had a statistically significant higher adiponectin level than male diabetic patients which could indicate a gender

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effect. Adiponectin levels were inversely related to insulin resistance; as patients with abdominal obesity had lower serum levels of adiponectin.

1. Introduction

The designation of the adipose tissue as a pivotal active endocrine organ has indeed drawn much scientific interest in the last few years. The adipose tissue is now viewed as the largest endocrine organ in the body (Oh et al., 2007). It secretes numerous bioactive proteins, collectively known adipocytes, into the circulation (Chandran et al., 2003). The most abundant of these adipocytokines is the adiponectin which is secreted by white adipose tissue and accounts for 0.01% of total plasma proteins (Gil-Campos et al., 2004; Heiker et al., 2010).

Adiponectin shares homology with collagen and complement 1q family (Simpson and Whitehead, 2010). It consists of 244 amino acids, which form four different domains (Sheng and Yang, 2008). Adiponectin modulates a number of metabolic processes via the activation of 5′-adenosine monophosphate-activated protein kinase (AMPK) and peroxisome proliferator activated receptor-α (PPAR-α) (Fagerberg et al., 2011). In addition, it plays an important role in the suppression of the metabolic derangements that cause insulin resistance and type 2 diabetes mellitus (type 2 DM) (Sheng and Yang, 2008).

Interestingly, although adiponectin is secreted by mature adipocytes, its plasma level shows a negative correlation with body fat mass. It has been found that adiponectin plasma level in obese individuals was lower than in non-obese ones (Arita et al., 2012). Adiponectin has been also shown to be negatively correlated with obesity-related diseases such as type 2 DM (Han et al., 2009). Furthermore, low adiponectin levels predicts the incidence of type 2 DM (Han et al., 2009). The latter findings have triggered a wealth of studies aiming at investigating the impact of circulating plasma adiponectin levels on enhancing insulin sensitivity in the diabetic patients (Fagerberg et al., 2011; Nayak et al., 2010; Weyer et al., 2001).

Diabetes types 2 as well as the impaired fasting glucose (IFG) are common among Jordanian population. The estimated age standardized prevalence rate of (IFG) and diabetes were 7.8% and 17.1%, respectively, with no significant gender differences according to a recent study (Ajlouni et al., 2008). To complicate things further, there are alarming rates of obesity and its associated co-morbidities among Jordanians, especially among women (Khader et al., 2008). This study aims to evaluate the serum levels of adiponectin in type 2 diabetic patients and to establish a correlation between adiponectin serum levels and insulin resistance in those patients. In contrast, previous studies had investigated the association of adiponectin serum levels and obesity and DM type 2. Jordan is an ideal place to conduct the current study due to the high prevalence of DM type 2 and prediabetes, as mentioned earlier.

2. Methods

2.1. Setting and participants

This is a cross-sectional study that has been conducted in the outpatient diabetes clinic of National Center for Diabetes, Endocrinology, and Genetics for 7 months. Eighty Jordanian subjects were included; 61 patients above 18 years diagnosed with type 2 diabetes for at least 6 months and 19 apparently healthy, medically free, and treatment naive individuals were recruited to serve as non-diabetic control. Type 1 diabetic patients, patients with acute or chronic kidney disease, patients with congestive heart failure, patients receiving thiazolidinedione (TZD) or exogenous insulin, and pregnant female patients all were excluded from the study.

Sample size calculation was conducted using an online tool (The Survey System, Creative Research Systems, www.survey-system.com). Using a confidence level of 95%, a minimum sample size of 79 subjects was calculated to be sufficient to conduct the study. An Institutional Review Board (IRB) approval was granted and an informed consent form, written in lay Arabic language, was handed to and signed by each subject.

2.2. Anthropometric measurements

All the anthropometric parameters including weight, height, and waist circumference (WC) were measured in a situation where subjects were in the standing position and wearing light clothing without shoes.

WC was measured in centimeters using constant tension tape at the end of a normal expiration at the point between the rib cage and the pelvis. Abdominal obesity was defined as WC $\geqslant$ 102 cm in males and $\geqslant$88 cm in female.

Body weight was measured in kilograms to the nearest 0.5 kg using a calibrated balance. Height was measured in centimeters to the nearest 0.5 cm. Body mass index (BMI) for each subject was calculated as body weight (in kilograms) divided by the square of body height (in meters). The BMI was classified into normal (8–24.9 kg/m^2), overweight (25–29.9 kg/m^2), obese (30–34.9 kg/m^2) and morbidly obese ($>$35 kg/m^2).

2.3. Sample collection and handling

Venous blood samples (6–8 ml) were collected in sterile plain tubes from all subjects after fasting for at least 10 h. Serum samples were separated by centrifugation of the coagulated blood samples at 4000 rpm for 5 min at 4 °C and then aliquoted and stored at −80 °C until the day of adiponectin level measurement using (ELIZA).