Assessment of Gamma glutamyl Transferase Activity among Type-2 Diabetic patient in Sulaimani Governorate

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Abstract

Increased levels of the liver enzyme, gamma glutamyl transferase (GGT) has been found to be associated with diabetes. Anthropometric measurement concerning GGT activity as well as body mass index and family history of the volunteers were investigated in sera of 115 (58 male and 57 female) patients with type-2 diabetes milletus against 60 (34 male and 26 female) as controls. A questionnaire form was used for collection characteristics of the patients and SPSS (version-16) as statistic tool analysis was applied to analyze the data obtained. The results obtained revealed a significant elevation ($P<0.05$) in GGT activity among diabetics (14.2±11.1 IU/L) as compared with control (10.5±8.0). The results were also showed a significant elevation ($P<0.05$) in diabetic patients with positive family history when compared with control. Gamma glutamyl transferase activity was found to be associated significantly with body mass index factor among diabetics. The study was conducted in Sulaimani Center for Diabetics and Endocrine Diseases from June through December 2010.

Keywords: Serum GGT, BMI, Family history, Type-2 DM.

Introduction

Diabetes mellitus (DM) is a group of metabolic diseases, characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both,[ADA, 2010]. Type 2 DM is caused by a combination of resistance to insulin action and an inadequate compensatory insulin secretory response. This form of DM,

accounts for approximately 90 - 95% of those with DM and was previously referred to as non-insulin dependent diabetes mellitus (NIDDM), or adult-onset DM [ADA, 2010]. Some studies linked oxidative stress (OS) and inflammation to β–cell dysfunction resulting from chronic exposure to hyperglycemia, free fatty acid, or a combination of the two [Warram *etal*, 1990; Ceriello, 2005]. A growing body of data reinforces the concept that inflammation also plays an important role in the pathogenesis of type 2 DM [Ford, 2003; Nakanishi *etal*, 2003]. Gamma-glutamyl transferase (GGT) (E.C.2.3.2.2) activity, normally found in serum as well as in the plasma membrane of virtually all cells except erythrocytes, catalyzes the first step in the degradation of extracellular glutathione (GSH), allowing for precursor amino acids to be assimilated and reutilized for intracellular GSH synthesis [Whitfield, 2001].Thus, GGT activity favors the cellular supply of GSH, the most important non-protein antioxidant of the cell. However, there is also clear evidence that the degradation of GSH can play a pro-oxidant role [Emdin *etal*, 2005]. Gamma-glutamyl transferase is therefore thought to have a role in oxidative mechanisms and is regarded as an early and sensitive marker of oxidative stress [Lim *etal*, 2004; Onat, 2006; Sharma, 2010]). Increased levels of the liver enzymes, Gamma-glutamyl transferase (GGT), Alanine aminotransferase (ALT) and Aspartate aminotransferase (AST) are known to be markers of NAFLD [Perry *etal,*1998; Wannamethee *etal,* 2005].They have been found to be associated with diabetes, cardiovascular risk factors and insulin resistance syndrome, even within normal reference intervals [Nilssen and Forde, 1994; Sakugawa *etal*,2004; Liu *etal*, 2005]. In many prospective studies, strong relationships between GGT or ALT concentrations and incident diabetes have also been observed in non-drinkers, in individuals with normal levels of liver enzymes, independently of classical cardiovascular risk factors [Vozarova *etal,* 2002; Sattar *etal,* 2004, Hanley *etal*, 2004]. However, a strong interaction between body mass index (BMI) and GGT has been described in diabetes [Lee *etal*, 2003a; Nakanishi *etal,* 2003]. A family history of diabetes mellitus (FHDM) is an established risk factor for type 2 diabetes, and is used as a convenient, first-line screening tool for diabetes [Harrison *etal,* 2003]. Several researchers have reported that increased GGT is independently associated with increased risk of type 2 diabetes in Asian and Caucasian populations [Lee *etal*, 2004a; Andre *etal*, 2005; Wannamethee *etal*, 2005]. Up to researcher's knowledge, no previous study had been conducted about GGT among diabetic patients neither in Sulaimani nor in Kurdistan region and the rest of Iraq. The aims of the present study are to measure the levels of serum liver enzyme GGT among known type 2 diabetic subjects, to evaluate the effect of

gender, BMI, on the GGT among the studied sample, and find the relation of GGT with family history of diabetes.

Materials and Methods

This is a case control study that has been conducted between June and December 2010 at the Sulaimani Centre for Diabetes and Endocrine diseases and the Central laboratory of Directory of health. Ethical Consideration of the study was approved by the scientific committee of the Directorate of Health. Permission was obtained from administrative authorities of Sulaimani Diabetic Center and Central laboratory prior to data collection. The detail of the work was explained for the participant and a verbal consent was taken from each person.

Chemicals

Commercial available kit was used to measure GGT (Biolabo, SA, Maizy, Franc). Materials used (not included in the kit) are all other chemicals and they were of analar grades.

Specimen collection

One hundred and fifteen diabetic patients (115) distributed as 58 males and 57 females, their age ranged between 32-78 years, were recruited in the study during their visit to the Sulaimani Centre for Diabetes and Endocrine disease. They were selected by random selection. They were diagnosed by consultants. For the comparative purpose, a comparable group (60 samples) which constitute of 34 males and 26 females, apparently healthy, non diabetic subjects from health workers, their age ranged between 31-68 years, were voluntarily included in the study. Samples included were characterized by the followings:

1. Adult aged 30 years and above. (both Diabetics and Control).
2. Patients diagnosed as diabetics by physician or have booklet.

(According to ADA-2010 criteria).

3. Overnight fasting, about 8 hours before taking the blood sample.

Samples excluded from the study were of:

1. History of alcohol consumption.
2. Patients taking drugs affecting liver enzymes, (Contraceptive pills, Statins).
3. Pregnant women.
4. Subjects with Positive HBsAg, Anti HCV.

Blood Collection

Blood sample were drawn using 5 ml syringes with steel needles, 5ml of venous blood was drawn from each patient and healthy controls, and immediately transferred to plain tube and were allowed to stand at room temperature for 20 min. for blood clotting. After centrifugation for 15 min. at 3000 rpm (revolution per minute) at room temperature for 5 min., the serum was immediately transferred to a second tube using a micro pipette and analyzed at the same day. The rest of the samples were stored at -26°C in the Central lab.

Methods

The study consisted of two parts: (1) a questionnaire and (2) Laboratory evaluation. The questionnaires included a socio-demographic characteristics like; Name, age, gender, residence. It also included smoking, duration of diabetes, hypertension, family history of diabetes, and drug history. Diabetes mellitus was defined as either clinical diagnosis of diabetes verified by participant's medical records or according to the criteria set by the report on expert committee on the diagnosis and classification of diabetes [ADA, 2010]. Weight had been measured while the patient minimally clothed without shoes using digital weight scale ,While height was measured in standing position without shoes using tape measure while the shoulder in normal state. BMI was calculated by dividing the weight (Kg) by the height squared (m^2) and categorized on the basis of the World Health Organization classification [WHO, 1998] are:

Normal weight (BMI 18.5 – 24.9 Kg/m^2),

Overweight (BMI $\geq$ 25 – 29.9 kg/m^2) and

Obesity (BMI $\geq$ 30 kg/m^2).

Gamma glutamyl transferase (GGT) activity determination:

Blood tests including fasting GGT, were measured.

Principle

This GGT activity protocol adopted was that of Szasz etal (1976), in which:

L-G-Glutamyl-p-nitroanilide + Glycylglycine $\xleftrightarrow{\text{GGT}}$ L-G-Glutamyl- Glycyl glycine + p-nitroaniline.

The rate of formation of P-nitroaniline, is directly proportional to the GGT activity in the sample, is measured at 405 nm.

RESULTS

Demographic data and other categorical variables like smoking, body mass index and hypertension among the studied groups are described in Table-1.

Table (1): Frequency distributions of categorical variables among studied sample.

Variables	Control (60) No. of total	%	Diabetics (115) No. of total	%
Body mass index groups				
Less than 25	16	(26.7)	23	(20.0)
25-29.9	26	(43.3)	49	(42.6)
30 and more	18	(30.0)	43	(37.4)
Family History of DM				
Yes	23	(38.3)	59	(51.3)
NO	37	(61.7)	56	(48.7)

The mean age ± SD and Mean BMI of the diabetic and control groups are illustrated in Table-2

Table (2): Age and BMI among Control and Diabetics.

Variables	Range	Mean ± SD
Age of Control (year)	31 – 68	47.6± 9.1
Age of diabetic (year)	32- 78	52.5 ± 10.5
BMI diabetic (kg/m^2)	20.0- 48	28.8 ± 4.6
BMI of Control (kg/m^2)	21.5- 38.327.8 ± 3.7	

The laboratory results show significantly higher mean GGT among diabetics as compared with control (14.2±11.1 IU/L vs. 10.5±8.0 IU/L) p= 0.024, Fig-1.

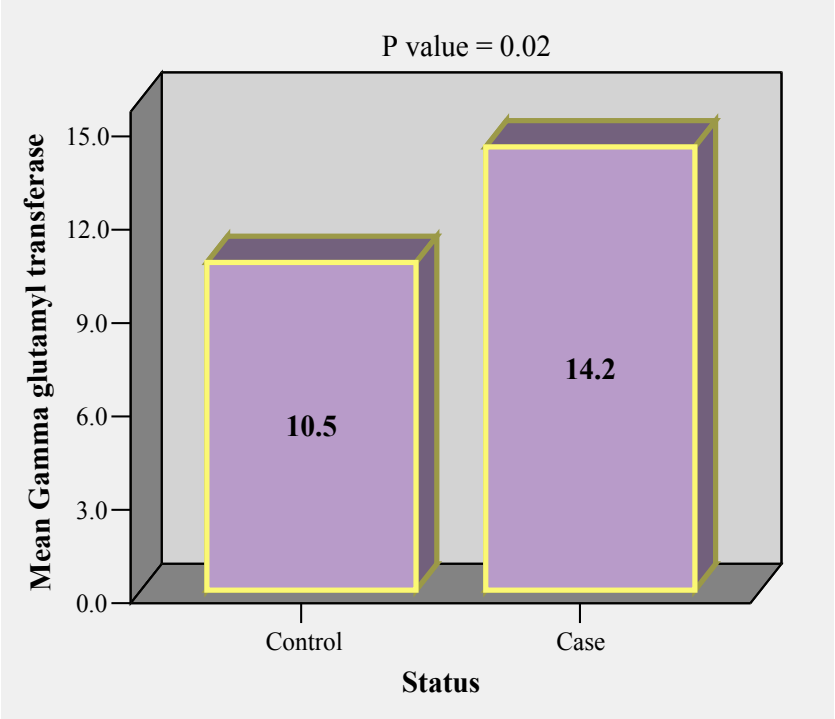

Figure (1): Mean GGT (IU/L) among Diabetic and Control group.

Family history of diabetes among first degree relatives, in both diabetic and control group, was significantly associated with higher mean GGT level.Table-3

Table (3): Relation of GGT with family history of Diabetes among Diabetics

Family history of diabetes among DM	% of total 115	GGT(IU/L) Mean ±SD	P value
Negative	48.7	11.4 ± 6.8	
Positive	51.3	16.8 ± 13.6	**0.009**
Total	100.0	14.2 ± 12.6	

GGT activity was found to have statistically significant association with body mass index with (P< 0.05) among diabetics (Fig-2), but not among control (p >0.05)

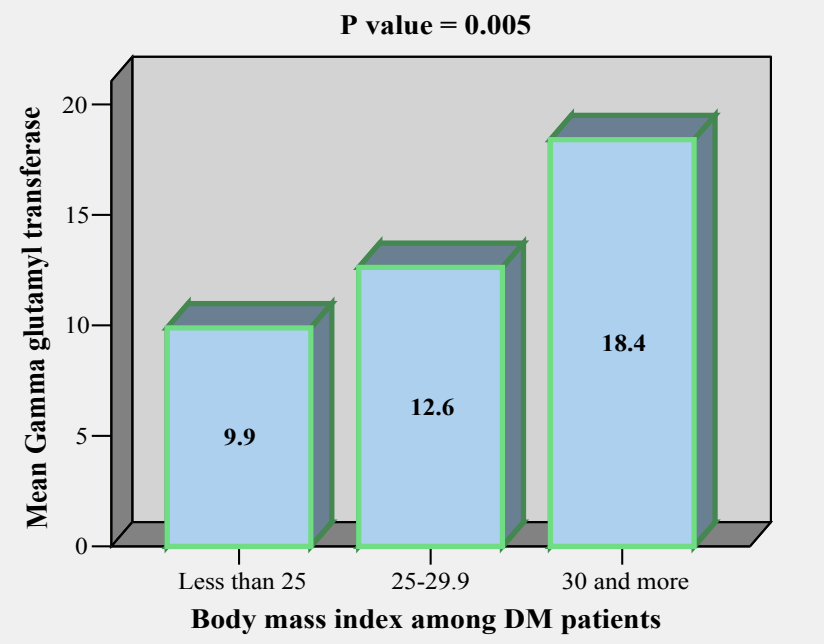

Fig (2) : BMI and GGT activity among diabetics.

Discussion

Gamma glutamyl transferase was first used as a test in the evaluation of liver diseases. It reaches extremely high levels in patients with biliary obstruction and is a good marker for chronic alcohol consumption [Lee *etal*, 2006a]. Many scientists think that GGT plays an important role in protecting against oxidative stress by maintaining an adequate supply of intracellular glutathione, which protects cells against oxidants produced by normal metabolism [Lim *etal*, 2004; Meisinger *etal*, 2005; Bo *etal*, 2005; Zhang *etal*, 2005]. However, other has noticed that increased levels of serum GGT do not seem to reduce oxidative stress, implying that increased GGT is not a protective mechanism against oxidative stress [Lim *etal*, 2004]. Numerous studies found that GGT is not just a marker of alcohol consumption, but is an independent predictor of many diseases, including cardiovascular diseases, type 2 diabetes, inflammation, and, possibly, underlying oxidative stress [Warram *etal*, 1990; Emdin *etal*, 2005; Sakuta *etal*, 2005; Wannamethee *etal*, 2005; Whitfield, 2001; Yamada *etal*, 2006]. The distribution of samples according to BMI, family history, and age were shown in table-1,2. In the current study, GGT level was significantly elevated ($p<0.05$) among diabetics than controls (fig-1), this result is in agreement With studies obtained previously [Balogun *etal*, 2008; Sharma *etal*, 2010]. The elevation in GGT activity may reflect an increased hepatic insulin resistance or oxidative stress. We can infer that much of GGT's association with disease is as a marker of preclinical effects that progress in time to

overt disease. Increase in GGT activity over time, even within the normal range, is associated with a change of insulin resistance markers and with a higher incidence of type 2 diabetes in both sexes [Philippe *etal*, 2006]. The GGT activity was found to have significant association (P<0.001) with first degree positive family history of diabetes in both diabetic and control group (table-3). The results were found to be in agreement with Inoue *et al*., (2008) and Yue *et al*., (2010), studies. A suggested explanation is that, elevated GGT was related to FHDM, independent of the other variables and also there is an additive interaction of family history and BMI on diabetes. In addition, GGT activity was found to associated significantly (P<0.005) with overweight, and obesity among the diabetics (fig-2). Similar results have been reported [Jousilahti *etal*, 2000; Al-Sultan AI, 2008; Azhar *etal*, 2009; Botton *etal*, 2007; Kasapoglu *etal*, 2010]. Association of Overweight, Obesity and abdominal fat distribution with increased GGT activity can be related to oxidative stress resulting from NAFLD, has been suggested in the mechanisms of insulin resistance, β-cell dysfunction, poorly-controlled type 2 diabetes, and subsequent complications [Kasapoglu *etal*, 2005; Bloomgarden, 2005; Wright *etal*, 2006]. Obesity particularly visceral or central (as evidence by the hip-waist ratio), is very common in type-2 DM. Adepocytes secrete a number of biologic products (leptin ,TNF-α, free fatty acids, resistin, and adiponectin) that modulate insulin secretion, insulin action and body weight and may contribute to the insulin resistance. Results from recent studies using data from the third NHANES study showed that all levels of GGT are strongly associated with C-reactive protein [Han *etal*, 2002; Sharma *etal*, 2010; Maryam *etal*, 2008]. This significant association might be a result of inflammation and oxidative stress in diabetes mellitus and that inflammatory markers, via their ability to enhance de novo hepatic fatty acid synthesis and fat accumulation, may contribute to both elevated liver enzymes and diabetes. These results strongly suggest that GGT is involved in the inflammatory pathway . Surprisingly, no any relations were found between GGT activity and cases of gender.

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تقييم نشاط الكاما كلوتمايل ترانسفريز في مرضى الداء السكري من النوع الثاني في محافظة السليمانية

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الخلاصة

ان زيادة مستويات الانزيم الكبدي كاما كلوتمايل ترانسفريز (GGT) تكون مرتبطة بداء السكري. تم قياس نشاط كاما كلوتمايل ترانسفريز و محتوى كتلة الجسم وكذلك تأريخ الاسرة المرضي للمتطوعيزوذلك في 115 نموذجا لمرضى السكري وبواقع 58 ذكور و 57 اناث مقابل 60 نموذجا من الاصحاء وبواقع 34 ذكور و 26 اناث. تم جمع المعلومات الشخصية للمرضى وطبق النظام الاحصائي SPSS نسخة 16 في تحليل النتائج. أظهرت النتائج ارتفاعا معنويا ($P<0.05$) في معدل نشاط (GGT) في المرضى (14.2±11.1IU/L) مقارنة بنشاطه عند الاصحاء(10.5±8.01IU/L) كما اظهرت النتائج ارتفاعا معنويا ($P<0.05$) في نشاط الانزيم في النماذج المرضية التي لها تأريخا اسريا في المرض مقارنة بالاصحاء. أتضح كذلك ان لانزيم كاما كلوتمايل ترانسفريز علاقة ارتباط ة مع محتوى كتلة الجسم. اجريت الدراسة في مركز السليمانية لامراض السكري والغدد الصماء للفترة من حزيران والى كانون الاول 2010.