The impact of metabolic syndrome in type 2 diabetic patients

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ABSTRACT

Objective: **To evaluate the impact of metabolic syndrome in patients with type 2 diabetes in Basrah, Iraq.** ***Design:*** **A prospective clinical study.** ***Setting:*** **Al-Mawani General Hospital, Basrah, Iraq.** ***Method:*** **One hundred-ten patients with type 2 diabetes were included. They were 41 males and 69 females. In addition, 108 control subjects were also included. They were 58 males and 50 females. Measurement of height, weight, waist circumference, blood pressure, fasting blood glucose, triglycerides and high density lipoprotein-cholesterol levels were carried out. The updated US National Cholesterol Education Program Adult Treatment Panel III (Updated NCEP ATP III) definition was used for the diagnosis of the metabolic syndrome.** ***Result:*** **The frequencies of the metabolic syndrome were significantly higher in type 2 diabetes male and female patients (75.6% and 94.2% respectively) compared to male and female controls (8.6% and 8.0% respectively), (P<0.001). The major determinants for the metabolic syndrome in male patients with the metabolic syndrome were, blood pressure (P<0.01), high density lipoprotein-cholesterol (P<0.01) and waist circumference (P<0.05). In female patients with the metabolic syndrome, the major metabolic syndrome determinants were waist circumference, triglycerides and high density lipoprotein-cholesterol (P<0.05).** ***Conclusion:*** **Patients with type 2 diabetes have a considerably high frequency of the metabolic syndrome. Hence, they are at a greater risk of atherosclerotic disease and its adverse clinical consequences. (MJBU,30,2: 2012, Page 85-90)**

أثر المتلازمة الأيضية على مرضى السكر من النوع 2

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الهدف: دراسة أثر المتلازمة الأيضية على مرضى السكر من النوع .2. **تصميم الدراسة:** دراسة سريرية إستباقية **مكان إجراء الدراسة:** مستشفى الموانيء في البصرة/ العراق. **المواد و طرق العمل:** في هذه الدراسة تم شمول 110 من مرضى السكر من النوع 2, وكانوا 41 ذكرا" و 69 أنثى, بالأضافة الى 108 من الأصحاء, و كانوا 58 ذكرا"و50 أنثى كمجموعة ضابطة. تم قياس كل من, الطول, الوزن, محيط الخصر, ضغط الدم, سكر الدم, الدهون الثلاثية، البروتينات الدهنية عالية الكثافة لدى المشاركين في الدراسة. تم إعتماد تعريف (NCEP ATP III) المحدث لتشخيص المتلازمة الأيضية. **النتائج:** ظهر ان تواتر المتلازمة الأيضية كان مرتفع بشكل معنوي بين مرضى السكر من الذكور و الأناث (75.6% و 94.2% على التوالي) مقارنة بالأصحاء من الذكور و الأناث (8.6% و 8.0% على التوالي), (ب< 0.001). وكانت أهم محددات المتلازمة الأيضية بين مرضى السكر من الذكور هي ضغط الدم (ب< 0.01), والبروتينات الدهنية عالية الكثافة (ب< 0.01) ومحيط الخصر (ب< 0.05). أما أهم محددات المتلازمة الأيضية بين مرضى السكر من الإناث فهي محيط الخصر, الدهون الثلاثية و البروتينات الدهنية عالية الكثافة (ب< 0.05). **الاستنتاجات:** لدى مرضى السكر من النوع 2 تواتر عالي جدا" للمتلازمة الأيضية, مما يجعلهم و بشكل كبير أكثر عرضة للإصابة بمرض تصلب الشرايين ومضاعفاته السريرية.

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INTRODUCTION

The prevalence of type 2 diabetes (T2D) has tripled in the last 30 years.[1] Currently, T2D afflicts more than 20 million people in the United States.[2] Although T2D is a heterogeneous disease, most patients with T2D have insulin resistance and the metabolic syndrome before the onset of T2D.[3] In fact, insulin resistance, hyperinsulinemia, dyslipidemia, and obesity precede the progression to T2D in 75% to 85% of patients.[4] The presence of the metabolic syndrome increases the risk and is highly predictive of new onset T2D.[5] The metabolic syndrome (syndrome X), also called "insulin resistance syndrome" is a cluster of disorders including central obesity, atherogenic dyslipidaemia, hypertension, impaired glucose tolerance as well as thrombotic and proinflammatory states.[6-9] That collection of diseases is associated with an increased risk of development of atherosclerosis, T2D and cardiovascular disease, thrombotic events and all–cause mortality.[10-12] It affects one in five people, and prevalence increases with age. Some studies estimate the prevalence of the metabolic syndrome in the United States to be up to 25% of the population.[13] It has been observed that the risk for incident T2D is up to 5 fold higher in individuals with the metabolic syndrome compared with those without the syndrome.[14] The presence of both the metabolic syndrome and insulin resistance has an additive effect, as these patients exhibit a 6-7 fold an increased risk for T2D.[15] This study was an attempt to evaluate the association between T2D and the metabolic syndrome and to evaluate the impact of the metabolic syndrome in T2D patients.

PATIENTS AND METHODS

This is a prospective clinical study, conducted from April 2009 throughout October 2011. It included 110 patients with T2D, 41 males and 69 females, 33-80 years of age, attending Diabetes Centre at Al-Mawani General Hospital, Basrah, Iraq. In addition, 108 apparently healthy subjects, 58 males and 50 females, 32-70 years of age were included as a control group. Height, weight, and waist circumference (WC), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured in patients and controls. The updated US National Cholesterol Education Program Adult Treatment Panel III (Updated NCEP ATP III) definition was used for the diagnosis of the metabolic syndrome.[7,16] Blood samples were collected in a fasting state and used for the estimation of fasting blood glucose (FBG) level and lipid parameters. FBG, triglycerides (TG) and high density lipoprotein-cholesterol (HDL-C) levels were estimated by enzymatic methods using kits from (Biocon for FBG, and Human for both TG and HDL-C). Statistical analysis was performed using SPSS program (version 16). The statistical differences was established by using the student's and Chi-square (X^2) tests. $P<0.05$ was considered to be statistically significant.

RESULTS

Table-1, presents the physiological and biochemical characteristics of T2D patients and controls. Among males, SBP ($P<0.05$), DBP ($P<0.001$), and FBG ($P<0.001$) were significantly higher among patients compared to controls. In females, Also, SBP ($P<0.05$), DBP ($P<0.01$), and FBG ($P<0.001$) were significantly higher among patients compared to controls. On the other hand, WC showed no significant differences among diabetic patients and controls ($P>0.05$). As shown in (Table-2), the frequencies of the metabolic syndrome were significantly higher in male and female patients with T2D (75.6% and 94.2% respectively) in comparison to male and female control subjects (8.6% and 8.0% respectively), ($P<0.001$). Table-3 presents the criteria of the metabolic syndrome in males. It demonstrated that, apart

from FBG, the significant metabolic syndrome determinants in T2D patients were BP (77.4%, P<0.01), HDL-C (48.4%, P<0.01) WC (64.5%, P<0.05). However, no significant differences shown with regard to TG (P>0.05). The criteria of the metabolic syndrome in women are presented in (Table-4). Apart from FBG, the significant metabolic syndrome determinants in T2D patients were WC (95.4%, P<0.05), TG (84.6%, P<0.05) and HDL-C (70.8%, P<0.05). On the other hand, no significant differences shown with regard to BP (P>0.05).

Table 1. Characteristics of T2D patients and control subjects

Parameter	T2D (Males) n=41	Controls (Males) n=58	T2D (Females) n=69	Controls (Females) n=50
Age (year)	56.3 (9.8)	45.0 (10.1)	51.2(10.2)	43.6(9.8)
WC (cm)	103.8 (10.7)	103.1 (9.9)	105.6(12.5)	102.2(13.1)
SBP (mm.Hg)	132.4 (18.1)*	125.4 (13.4)	129.6(20.4)*	122.7(10.6)
DBP (mm.Hg)	84.2 (13.5)***	74.7 (9.2)	79.1(13.5)**	71.9(10.1)
FBG (mg/dl)	179.0 (57.8)***	88.4 (10.0)	192.0(73.0)***	88.8(7.4)

Values are given in mean(SD).

: P < 0.05, **: P < 0.01 ,: P < 0.001 (T2D patients vs controls)**

Table 2. The frequency of the metabolic syndrome among T2D patients and control subjects.

Metabolic syndrome status		T2D patients		Controls	
		No.	%	No.	%
Males	Present	31	75.6***	5	8.6
	Absent	10	24.4	53	91.4
	Total	41	100.0	58	100.0
Females	Present	65	94.2***	4	8.0
	Absent	4	5.8	46	92.0
	Total	69	100.0	50	100.0

***: P < 0.001 (T2D patients vs controls)**

Table 3. Metabolic syndrome criteria among males

Metabolic syndrome criteria	T2D patients with MS (n=31)		T2D patients without MS (n=10)		Controls with MS (n=5)		Controls without MS (n=53)	
	No.	%	No.	%	No.	%	No.	%
BP≥130/85mm.Hg	24 **	77.4	1	10.0	5***	100.0	4	7.5
WC ≥102cm	20*	64.5	1	10.0	5	100.0	23	43.4
FBG ≥ 100mg/dl	31	100.0	10	100.0	0	0.0	2	3.8
TG ≥150mg/dl	27	87.1	6	60.0	3	60.0	12	22.6
HDL < 40mg/dl	15**	48.4	0	0.0	2***	40.0	0	0.0

***: P<0.05, ** : P<0.01 (Patients with MS vs patients without MS)**

**** : P<0.01 (Controls with MS vs controls without MS)**

Table 4. Metabolic syndrome criteria among females

Metabolic syndrome criteria	T2D patients with MS (n=65)		T2D patients without MS (n=4)		Controls with MS (n=4)		Controls without MS (n=46)	
	No.	%	No.	%	No.	%	No.	%
BP≥130/85mm.Hg	46	70.8	2	50.0	4***	100.0	1	2.2
WC ≥ 88cm	62*	95.4	2	50.0	4	100.0	40	87.0
FBG ≥ 100mg/dl	65	100.0	4	100.0	0	0.0	0	0.0
TG ≥150mg/dl	55*	84.6	1	25.0	4**	100.0	9	19.6
HDL < 40mg/dl	46*	70.8	0	0.0	0	0.0	5	10.9

***: P<0.05 (Patients with MS vs patients without MS)**

****: P<0.01, ***: P<0.001 (Controls with MS vs controls without MS)**

DISCUSSION

Diabetes is the most significant metabolic disease as it leads to a broad spectrum of microvascular and macrovascular complications including end-stage vascular disease, cardiovascular damage and retinopathy. Consequently, a large burden is imposed on the national health system of countries all over the world.[17] T2D, which accounts for 90 per cent of all diabetes, has become one of the major causes of premature morbidity and mortality, mainly via the increased risk of cardiovascular disease which is responsible for up to 80 per cent of these deaths.[18] The clinical significance of the metabolic syndrome arises from its association with T2D and cardiovascular disease.[17] Metabolic syndrome in people with T2D, appear to confer a substantial additional health risks particularly cardiovascular risk over and above the sum of the risk associated with each single abnormality.[19] The present study revealed a remarkably higher frequency of the metabolic syndrome among T2D patients in either sex in comparison to their respective controls. Among diabetics, the frequency of the metabolic syndrome was even more higher among females than males. This could be explained by increased prevalence of obesity in women as a result of several cultural and social factors such us multiple pregnancies, high unemployment, over eating and physical inactivity.[20,21] These results are in agreement with the observation of others.[22-25] The higher frequency of the metabolic syndrome in T2D patients reported in this study could be, at least partly, also attributed to stressful factors to which our patients are exposed to. Chronic psychosocial stress may lead to chronic excess cortisol, which in turn may play a role in the pathogenesis of the metabolic syndrome.[26] The present study demonstrated that the major metabolic syndrome determinants in T2D patients were BP, HDL-C and WC in males, and WC, TG and in females HDL-C respectively. Central obesity measured by WC was found by the present study to be a major determinant for the development of the metabolic syndrome among diabetic male and female patients. This could be due to sedentary life style and lack of physical activity. [27] This is in agreement with other studies.[24,28] It has been found that, among the five components of the ATP III criteria, waist circumference was the single most common parameter to likely meet the metabolic syndrome criteria.[29] Similarly, a low HDL-C level is also found to be a significant metabolic syndrome determinant in diabetic patients in either sex. Reduced HDL-C is a major independent cardiovascular risk factor of atherogenic dyslipidaemia, as HDL-C protects against an increase in TG or LDL-C levels.[30,31] The same finding was observed by others.[24,28] An elevated BP level was a significant metabolic syndrome determinant in T2D male patients, however it was non-significantly elevated among female patients. The insulin resistance can directly affect vascular signaling,

eventually leading to proliferation of smooth muscle cells in the vessel wall and increased rates of intimal expansion and eventually a high BP.[32] This is in agreement with others.[24] In addition, obese people tend to have an elevated BP compared with lean people.[6] An elevated TG level was a significant determinant of the metabolic syndrome in diabetic female patients, however it was non-significantly higher among male patients with the metabolic syndrome. This observation is similar to that of others.[24,28] The high TG level in association with the metabolic syndrome could due to the presence of insulin resistance. Lipolysis in adipocytes is enhanced, plasma concentrations of free fatty are transported to liver and muscle. In the liver, some are oxidized, and most are re-esterified to form TG. At the same time, insulin drives lipogenesis in the liver directly. Elevated plasma glucose concentrations may also increase hepatic TG synthesis by providing the carbon skeleton for glycerol.[33] Furthermore, LDL particles occurs in association with the metabolic syndrome and atherogenic dyslipidaemia tend to be small and dense 6. and are more atherogenic.[34-36] It has been suggested that non-diabetic persons with the metabolic syndrome are at a substantial risk for the development of T2D. The risk of T2D is up to 5 fold higher in patients with the metabolic syndrome.[37] In addition, the greatest impact of T2D is the 2-4 times greater risk of coronary heart disease and cerebrovascular disease.[38] Furthermore, the more components of the metabolic syndrome that are accumulated, the higher is the cardiovascular mortality rate.[39] We conclude that patients with T2D have a distinctly high frequency of the metabolic syndrome. Thus, they are at a considerably risk of atherosclerotic cardiovascular disease and cerebrovascular disease, and their clinical complications.

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