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Study of the relationship between male erectile dysfunction and type 2 diabetes mellitus/metabolic syndrome and its components

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Abstract

Aim: To study the relationship between erectile dysfunction and type 2 diabetes mellitus (T2DM)/metabolic syndrome (MetS).

Methods: This prospective study invited male patients with T2DM attending for a routine outpatient check-up to complete two questionnaires. A general questionnaire was used to collect demographic and clinical characteristics, while sexual function was assessed using the International Index of Erectile Function scoring system. The prevalence of MetS in this patient population was determined using information from the general questionnaire. Risk factors for erectile dysfunction were identified using univariate and multivariate logistic regression analyses.

Results: A total of 175 patients provided valid questionnaires; of these, 148 (84.6%) had MetS. The prevalence of erectile dysfunction was 90.9% (159/175) in the entire survey population compared with 89.2% (132/148) in patients with MetS. Multivariate logistic regression analysis identified the following risk factors for erectile dysfunction in patients with T2DM and/or MetS: age, blood pressure and duration of diabetes.

Conclusion: These current findings suggest that the MetS and its components have a negative impact on male erectile function.

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Introduction

Metabolic syndrome (MetS) is a general term used to describe a group of metabolic disorders that includes central obesity, hypertension, hypertriglyceridaemia, low levels of high-density lipoprotein cholesterol (HDL-C) and decreased glucose tolerance.[1] The International Diabetes Federation Task Force on Epidemiology and Prevention, the National Heart, Lung, and Blood Institute, the American Heart Association, the World Heart Federation, the International Atherosclerosis Society, and the International Association for the Study of Obesity published a joint statement in order to harmonize the definition of MetS. The statement says that MetS can be diagnosed with a body mass index (BMI) $>30\,kg/m^2$ with any two of the following:[1,2] (i) raised triglycerides (TG) >150 mg/dl (>1.7 mmol/l), or specific treatment for this lipid abnormality; (ii) reduced HDL-C <40 mg/dl (<1.04 mmol/l) in males, <50 mg/dl (<1.29 mmol/l) in females, or specific treatment for this lipid abnormality; (iii) raised blood pressure: systolic blood pressure $>$ 130 or diastolic blood pressure >85 mmHg, or treatment of previously diagnosed hypertension; (iv) raised fasting plasma glucose (FPG): >100 mg/dl (>5.6 mmol/l), or previously diagnosed type 2 diabetes mellitus (T2DM).[1,2] If FPG is >100 mg/dl (>5.6 mmol/l), an oral glucose tolerance test is strongly recommended, but is not necessary to confirm the presence of MetS.[2] If BMI is $>30\,kg/m^2$, central obesity can be assumed and waist circumference does not need to be measured.[2]

The global epidemic of obesity and T2DM has resulted in an increasing number of patients suffering from MetS.[3] This is of particular concern because of the close association between MetS and cardiovascular disease (CVD).[4] There is also growing evidence that MetS might be associated with male sexual dysfunction.[5] With this growing understanding of the close associations between various pathological states, T2DM, CVD, obesity, erectile dysfunction and hypogonadism are no longer regarded as separate diseases in elderly men.[6] However, the relationship between MetS, erectile dysfunction and hypogonadism remains unclear and needs to be further elucidated.[7] The aims of this study were to evaluate the prevalence of erectile dysfunction among patients with T2DM and/or MetS, and to evaluate the relationship between the components of MetS and male sexual dysfunction.

Patients and methods

Study population

This prospective study enrolled consecutive male patients with confirmed T2DM between September 2011 and March 2012 in the Department of Urology, The First Affiliated Hospital, School of Medicine, Xi'an Jiaotong University, Xi'an, Shaanxi Province, China. T2DM was diagnosed according to the American Diabetes Association as follows:[8] FPG ≥ 7.0 mmol/l, random blood sugar ≥ 11.1 mmol/l or glucose ≥ 11.1 mmol/l 2 h after an oral glucose tolerance test. All of the patients had normal thinking ability, were able to express independent judgement and answer questions, and were willing to co-operate with the investigation. The inclusion criterion was the confirmed diagnosis of T2DM, while the exclusion criteria were as follows: presence of psychological disorders;

hyperprolactinaemia; primary hypogonadism; pituitary tumours; bilateral/unilateral cryptorchidism; testicular inflammation; severe anaemia; prostate cancer; genital malformations; spinal cord injury; genitourinary surgery; dysplasia; thyroid disease; endocrine disorders (e.g. hyperthyroidism, systemic lupus erythematosus); connective tissue disease; cancer; blood diseases; severe peripheral vascular disease; poor peripheral perfusion; severe liver or kidney dysfunction; and other organic diseases.

Ethical approval for the study was provided by the Ethics Committee of Xi'an Jiaotong University (no. 61-1203/R). All participants provided written informed consent and all were given free access to the study results.

Investigational methods

The sample size and power were not predetermined before the study commenced as it was a prospective study with a set time period. Two questionnaires, a general questionnaire and a sexual function questionnaire, were distributed to patients with T2DM who attended the hospital for a routine outpatient check-up. The general questionnaire asked questions regarding age, occupation, residence, marital status, educational status, family monthly income, lifestyle, level of education, smoking status, alcohol drinking status, exercise, and disease history (hypertension [controlled by medication], T2DM and hyperlipidaemia, coronary heart disease, arrhythmia, peripheral vascular disease and brain vascular disease). Patients answered questions regarding the current status (normal or abnormal) of their metabolic parameters, including blood cell counts, myocardial enzyme levels, blood glucose concentration, blood lipid levels, liver function test results, and renal function test results, which were later tested and confirmed at the hospital. Whilst at the hospital, the patients also had the following parameters measured: blood pressure, height, weight, waist circumference and hip circumference.

The sexual function questionnaire consisted of two parts: (i) patients who had not had sexual intercourse within the past 6 months needed to answer about the time span without sexual intercourse, night-time or early-morning erections, and the reasons for intercourse termination; and (ii) patients who had had sexual intercourse within the past 6 months completed the International Index of Erectile Function (IIEF-5).[9] The IIEF-5 consists of five questions, each scored on a five-point ordinal scale (0–5), where lower values represent poorer sexual function. The questions address five areas related to the patient's ability to achieve and maintain an erection that resulted in satisfactory intercourse over the previous 6 months. The possible scores for the IIEF-5 range from 1 to 25 (one question has scores of 1–5). Patients with a score of $\geq$22 were considered to have normal erectile function and subjects with a score of $<$22 were considered to have erectile dysfunction ($\leq$7 = severe erectile dysfunction; 8–11 = moderate; 12–16 = mild-to-moderate; 17–21 = mild). Patients completed the IIEF-5 questionnaire themselves under the supervision of trained medical staff. All questionnaires were then collected from the patients by the medical staff.

Statistical analyses

All statistical analyses were performed using the SPSS® statistical package, version 13.0 (SPSS Inc., Chicago, IL, USA) for Windows®. A univariate logistic regression analysis of data from the entire survey population was undertaken on the study parameters after having selected potential risk factors based on the published literature and research. Multivariate logistic regression analysis of data from the entire survey population was then undertaken on the

parameters that were either statistically significant in the univariate logistic regression analysis or on parameters that might have some expected association with erectile dysfunction in order to determine the risk factors for erectile dysfunction. The results are expressed as odds ratio and 95% confidence interval. A P-value <0.05 was considered statistically significant.

Results

A total of 186 questionnaires were distributed to male patients with T2DM attending the hospital for a routine check-up. From these men, the medical staff collected 175 (94.1%) valid questionnaires (11 of the 186 were incomplete; therefore, they were not included in the study). Fifteen patients were aged ≤40 years, 71 were aged 41 – 55, 55 were aged 56 – 70, and 34 were aged >70. The mean ± SD age of the entire survey population ($n = 175$) was 56.74 ± 13.10 years (range 35–80 years). Based on the information provided in the general questionnaires, 148 patients (84.6%) met the criteria for a diagnosis of MetS. The mean ± SD age of the MetS group ($n = 148$) was 59.62 ± 11.91 years (range 48–80 years). The mean ± SD age of the patients that had T2DM but not MetS ($n = 27$ [15.4%]) was 40.96 ± 6.41 years (range 35–58 years).

Based on the information provided by the IIEF-5 questionnaire, the prevalence rate of erectile dysfunction was 90.9% (159/175) in the entire survey population compared with 89.2% (132/148) in patients with MetS and 100.0% (27/27) in patients with T2DM but not MetS. The rates of mild, mild-to-moderate, moderate and severe erectile dysfunction amongst the entire survey population were 30.9% (54/175), 18.9% (33/175), 13.7% (24/175), and 27.4% (48/175), respectively.

Univariate logistic regression analysis of data from the entire survey population for MetS and its components showed that duration of T2DM and serum TG levels were significantly correlated with prevalence of erectile dysfunction ($P = 0.002$ and $P = 0.029$, respectively; Table 1). The longer the duration of T2DM, the higher the prevalence of erectile dysfunction; and the higher the TG levels, the higher the prevalence of erectile dysfunction. BMI, FPG levels, duration of hypertension, HDL-C levels and the presence of MetS itself were not associated with risk of erectile dysfunction.

Prevalence rates of erectile dysfunction in each age group of the entire survey population were as follows: ≤40 years, 66.7% (10/15); 41–55 years, 88.7% (63/71); 56–70 years, 94.5% (52/55); >70 years, 100.0% (34/34). Univariate logistic regression

Table 1. Univariate logistic regression analysis of the association between erectile dysfunction and duration of diabetes, triglyceride (TG) levels, age, monthly income, levels of physical activity and blood pressure in Chinese male patients with type 2 diabetes mellitus (T2DM) and/or metabolic syndrome ($n = 175$).

Parameter	Reference value	Standard error	Wald χ^2-test	Statistical significance	OR	95% CI	
						Lower	Upper
Duration of T2DM	1.165	0.376	9.609	$P = 0.002$	3.207	1.535	6.702
TG	0.684	0.314	4.748	$P = 0.029$	1.981	1.071	3.664
Age	1.409	0.331	18.124	$P < 0.001$	4.090	2.139	7.823
Monthly income	0.787	0.339	5.397	$P = 0.02$	2.196	1.131	4.266
Physical activity	1.293	0.357	13.118	$P < 0.001$	3.643	1.810	7.333
Blood pressure	0.541	0.223	5.887	$P = 0.015$	1.717	1.110	2.658

OR, odds ratio; CI, confidence interval.

analysis of data from the entire survey population showed that age was significantly correlated with prevalence of erectile dysfunction ($P < 0.001$, Table 1). The older the patients, the higher the prevalence of erectile dysfunction.

Univariate logistic regression analysis of data from the entire survey population showed that monthly income was significantly correlated with prevalence of erectile dysfunction ($P = 0.02$, Table 1). The lower the income, the higher the prevalence of erectile dysfunction.

Univariate logistic regression analysis of data from the entire survey population showed that the levels of physical activity were significantly correlated with prevalence of erectile dysfunction ($P < 0.001$, Table 1). The lower the level of physical activity, the higher the prevalence of erectile dysfunction.

Univariate logistic regression analysis of data from the entire survey population also showed that blood pressure was significantly correlated with prevalence of erectile dysfunction ($P = 0.015$, Table 1). The higher the blood pressure, the higher the prevalence of erectile dysfunction. The remaining factors such as educational status, smoking status, alcohol drinking status, waist circumference, hip circumference and weight were not associated with risk of erectile dysfunction.

Multiple potential risk factors for erectile dysfunction in male patients with T2DM and/or MetS were used in a multivariate logistic regression analysis of data from the entire survey population. The results showed that there were three risk factors for erectile dysfunction: age, blood pressure and duration of diabetes (Table 2).

Discussion

Metabolic syndrome has become a global public health problem.[3] The initial clinical interest in this syndrome was due to its association with CVD and the growing epidemic of T2DM throughout the world.[10] There is a high degree of overlap between the cause of erectile dysfunction and CVD.[11] With the global epidemic of obesity and T2DM, research has demonstrated that MetS has a secondary association with male sexual dysfunction and that erectile dysfunction is significantly associated with MetS.[12] Several studies have evaluated the relationship between sexual dysfunction and prevalence of MetS. In a study of 236 male patients with MetS, 96.5% had erectile dysfunction, 39.6% loss of libido, 22.7% premature ejaculation and 4.8% ejaculation delay.[13] The phenomenon of gonadal dysfunction was more common in patients with MetS compared with healthy individuals.[12] In another study, of 2371 males aged 30–69 years, prevalence of MetS was 34% in males >50 years of age.[14] MetS was independently associated with a decreased IIEF-5 score.[14] It is worth noting that this study also showed that there was a higher proportion of moderate-to-severe erectile dysfunction in older men ($\geq$50 years) with MetS compared with younger men (<50 years) without MetS.[14] A further study of 393 male patients aged 40–70 years with erectile dysfunction demonstrated that MetS was significantly correlated with incidence of moderate-to-severe ED,[15] while Demir et al. showed that a decrease in the erectile dysfunction symptom score was significantly correlated with an increase in the number of metabolic risk factors.[16] The Massachusetts Male Aging Study further confirmed that the presence of MetS was still associated with an increased risk of erectile dysfunction even in a population whose BMI was <25 kg/m^2 (relative risk 2.09).[17]

The results of this present study showed that increasing age was significantly associated with an increase in prevalence of erectile dysfunction. Univariate and multivariate logistic regression analyses demonstrated that age, duration of T2DM, TG levels, blood pressure, monthly income and physical activity were risk factors for erectile

Table 2. Multivariate logistic regression analysis of the association between erectile dysfunction and multiple potential risk factors in Chinese male patients with type 2 diabetes mellitus (T2DM) and/or metabolic syndrome ($n = 175$).

Parameter	Reference value	Standard error	Wald χ^2-test	Statistical significance	Exp (B)	95% CI	
						Lower	Upper
Residence	−0.103	0.650	0.025	NS	0.902	0.252	3.225
Monthly income	1.079	0.780	1.917	NS	2.943	0.638	13.567
Physical activity	0.310	0.674	0.212	NS	1.364	0.364	5.112
Living in a couple	0.159	0.642	0.062	NS	1.173	0.333	4.132
Education status	0.186	0.707	0.069	NS	1.204	0.301	4.817
Smoking status	0.060	0.615	0.009	NS	1.062	0.318	3.545
Drinking status	0.372	0.737	0.256	NS	1.451	0.343	6.149
WHR	0.042	0.718	0.003	NS	1.043	0.255	4.266
Waist circumference	0.110	0.710	0.024	NS	1.116	0.278	4.491
BMI	−0.457	0.611	0.558	NS	0.633	0.191	2.100
Duration of T2DM	2.015	0.689	8.548	$P = 0.003$	7.499	1.943	28.945
Fasting plasma glucose	0.478	0.675	0.502	NS	1.613	0.430	6.055
Glycosylated haemoglobin	−1.141	0.836	1.862	NS	0.320	0.062	1.645
Blood pressure	1.659	0.635	6.814	$P = 0.009$	5.253	1.512	18.253
Duration of hypertension	0.383	0.719	0.284	NS	1.467	0.358	6.003
TG levels	0.122	0.636	0.037	NS	1.130	0.325	3.927
HDL-C	−0.579	0.600	0.933	NS	0.560	0.173	1.815
MetS	0.735	0.653	1.268	NS	2.086	0.580	7.503
Age	1.680	0.670	6.284	$P = 0.012$	5.367	1.443	19.963

Exp (B), exponentiation of the coefficients; CI, confidence interval; WHR, waist-to-hip ratio; BMI, body mass index; TG, triglycerides; HDL-C, high-density lipoprotein cholesterol; MetS, metabolic syndrome; NS, not significant ($P \geq 0.05$).

dysfunction in patients with T2DM and/or MetS. These current findings suggest that MetS and its components have a negative impact on male erectile function, and the relationship between the duration of T2DM was particularly significant with erectile dysfunction. This study was limited by the fact that the sample size and power were not predetermined before the start.

In conclusion, these current findings suggest that patients with erectile dysfunction should be carefully examined to see if they have T2DM and/or MetS. Conversely, when managing male patients with T2DM and/or MetS, medical staff should be aware of the potential impact that these diseases have on sexual function and they should actively enquire about the patient's experience of erectile dysfunction.

Declaration of conflicting interest

The authors declare that there are no conflicts of interest.

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