Association of erectile dysfunction with cardiovascular risk factors and increasing existing vascular disease in male Chinese Type 2 diabetic patients

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Introduction

Erectile dysfunction (ED) is a prevalent health problem and impacts considerably on the quality of life of middle-aged men (1). Previous studies have reported an association between ED, vascular disease (2,3) and cardiovascular risk factors (2-5), with ED being reported to be both a symptom and marker of vascular disease progression (6,7). In Hong Kong there is a high prevalence of diabetes and other risk factors, with 22.6% of older males (65-74 years) having diabetes, 37.2% dyslipidaemia, and 51.7% hypertension (8). The Massachusetts Male Aging Study emphasised the close relationship between diabetes and ED which was three times more prevalent in diabetic subjects than their non-diabetic counterparts (28% vs. 10%) (2). The high prevalence of diabetes and other risk factors may therefore have a significant impact on the prevalence of ED in Hong Kong.

Methods

Patients were diagnosed as having Type 2 diabetes using WHO criteria (9), and underwent structured assessments using the EuroDiab Protocol (10). They were seen in a teaching hospital and tertiary referral centre, but the government-funded health care system is such that many patients use the facility as their only source of subsidised medical care, and represent patients of low and middle income socioeconomic status.

All patients gave written, informed consent. Assessments for micro- and macrovascular disease, including retinopathy, peripheral vascular disease (PVD), and, middle cerebral artery (MCA) stenosis using transcranial doppler, blood pressure, and fasting biochemical parameters were performed as described previously (11,12). ED was defined using the 1993 NIH Consensus Conference, namely the inability to achieve or maintain an erection sufficient for satisfactory sexual activity in the previous year. Difficulty in developing or maintaining a penile erection sufficient for sexual performance ED was reported during a physician-conducted diabetes complication screening.

Differences in parameters between those with and without ED were examined using the t-test and χ^2-test. Backwards logistic regression analysis was used to determine independent predictors of ED. The following variables were incorporated into the model in three stages: firstly, age, age of diabetes onset and duration; secondly, body mass index, waist circumference, haemoglobin A1c, triglycerides, HDL-cholesterol levels, urinary albumin-creatinine ratio, and treatments for, and histories of hypertension and diabetes, alcohol consumption and smoking; and thirdly, neuropathy, MCA stenosis, PVD, and retinopathy.

Results

From the 1078 patients aged >30 years recruited, 24.5% reported having ED. Patients reporting ED were generally older and the prevalence increased significantly with age increasing from 6.8 to 35.8% in those aged 30-39 to those >70 years. ED patients had worse glycaemic control, despite more having glucose-lowering treatment ($p<0.05$, Table). Systolic blood pressure was higher in the ED patients, although 1.7 times more ED patients were receiving blood pressure-lowering pharmacotherapy ($p<0.001$). In univariate analysis, increasing glycaemia and hypertension increased the risk for having ED with odds ratios (95%CI) of 2.8 (1.2-6.8) and 1.8 (1.3-2.4), respectively, but not after adjustment for age and diabetic duration. ED patients had worse renal function, and increased levels of micro- and most macrovascular complications (Table, $p<0.05$)

Independent predictors of ED were determined in three stages. Age [aged 40-49, 50-59, 60-69, ≥70 years having odds ratio (95%CI) of 2.5 (1.2-5.0), 5.9 (3.0-11.5), 5.3 (2.7-10.4), and 6.8 (3.3-14.1) compared to those aged 30-39 years, respectively] and duration of diabetes [1.1 (1.02-1.3)] were found to be independent predictors ($\chi^2=72.3$, $R^2=0.10$, all $p<0.001$). When anthropometric and biochemical parameters were incorporated into the regression analyses, age remained an independent predictor of ED, and albumin-creatinine ratio [1.3 (1.04-5.6)] and being on treatment for diabetes [4.6 (2.1-10.3)] were also included ($\chi^2=84.2$, $R^2=0.16$, all $p<0.001$). Inclusion of concomitant vascular disorders resulted in age, diabetic treatment [3.2 (1.3-7.8)] and neuropathy [2.9 (1.7-4.8)] being predictors of ED ($\chi^2=49.9$, $R^2=0.16$, all $p<0.001$).

Discussion

Increasing age was closely related to ED, which is similar to observations in other populations (2,13-16). In Caucasians, risk increased 3.6 times in men aged 50-59 compared to those aged 18-29 years (2). The age-related risk in these diabetics was even greater at 5.6 (2.5-12.4) comparing the 50-59 year age group with those aged 30-39 years, suggesting diabetes may accentuate the effects of ageing on ED. Similarly, diabetic duration, a function of age, was also an independent predictor of ED, and probably reflects the cumulative contribution of risk factors to the development of ED.

Increasing glycaemia increased the risk of ED. Even moderately high glucose levels affect the vasculature (17), and result in the accumulation of advanced glycation end products (18) that promote vascular disease and neuropathy, and thus contribute to ED (18). Penile erection relies on neural stimulation of the penile vasculature endothelium and corpus cavernosum lacunae to trigger lacunae and smooth muscle relaxation and vasodilatation, which promotes filling and erection (19). Risk factors cause vascular damage, diminishing the response at a number of stages, promoting ED (17). Indeed, the albumin-creatinine ratio, a marker of renal function and vascular disease, was an independent predictor of ED, and existing vascular disorders were increased with ED. Asymptomatic MCA stenosis was commonly identified (~20%) but was not associated with ED, suggesting the pathogenesis of this condition may involve a different pattern of risk factors, and may contribute to the high prevalence of stroke in Chinese populations (11,12).

The observed prevalence of ED of 24.5% is lower than the 63.6% from a smaller Hong Kong study (14), but is comparable to a Singaporean study that reported 23.2% had mild ED (13). The disparity is probably due to methodological differences in diagnostic criteria, population selection and recruitment timing, meaning direct comparisons of studies must be interpreted with caution, but do give an estimate of the disease magnitude between the populations. ED patients often do not spontaneously seek help for their condition (6). Therefore, opportunistic screening for ED during visits to healthcare workers could help initiate early interventions to treat the ED and concomitant vascular risk factors to limit the progression of the associated diabetic complications.

In conclusion, Chinese diabetic patients with ED have higher levels of modifiable risk factors associated with vascular disease. Early recognition of ED and risk factor modification should reduce vascular disease.

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Table: Biochemical, anthropometric and complications parameters in 1078 male Type 2 diabetic Chinese subjects with and without erectile dysfunction

Parameters	Erectile function		P values	
	Normal (n=814)	Dysfunction (n=264)	t-test	ANCOVA
Number (total n=1078)	814	264	-	-
Age (years)	53.6 ± 12.5	60.0 ± 10.8	<0.001	-
Age at diabetes diagnosis (years)	48.4 ± 12.5	52.6 ± 12.0	<0.001	-
Duration of diabetes (years)	5.1 ± 5.3	7.4 ± 5.7	<0.001	-
Systolic blood pressure (mm Hg)	133 ± 20	138 ± 23	<0.001	NS
Diastolic blood pressure (mm Hg)	80 ± 12	79 ± 12	0.088	NS
Glucose (mmol/L)	8.2 (8.0-8.4)	8.7 (8.3-9.1)	0.022	0.037
Glycosylated haemoglobin A_{1c} (%)	7.5 (7.4-7.8)	7.8 (7.6-8.0)	0.048	0.084
Total cholesterol (mmol/L)	5.3 ± 1.2	5.4 ± 1.2	NS	NS
HDL-cholesterol (mmol/L)	1.17 ± 0.32	1.17 ± 0.34	NS	NS
LDL-cholesterol (mmol/L)	3.4 ± 1.0	3.5 ± 0.9	NS	NS
Triglyceride (mmol/L)	1.43 (1.36-1.50)	1.37 (1.27-1.48)	NS	NS
Albumin-creatinine ratio (mg/mmol)	2.6 (2.3-2.9)	5.1 (3.9-6.5)	<0.001	0.001
Body mass index (kg/m^2)	24.8 ± 3.7	24.1 ± 3.3	0.006	NS
Waist circumference (cm)	86.9 ± 9.4	86.6 ± 9.0	NS	NS
Peripheral vascular disease	5.6	13.3	<0.001	
Cardiac failure	1.2	3.8	0.012	
Coronary artery bypass graft (CABG)	0	2.8	0.004	
Neuropathy	16.3	45.4	<0.001	
Retinopathy	23.2	40.7	<0.001	
Middle cerebral artery stenosis	20.1	24.3	NS	
Myocardial infarction	1.7	4.6	0.018	
ACR micro/macroalbuminuria	19.6/12.5	26.4/21.2	<0.001	
Prevalence of hypertension (Rx)	46.1 (27.3)	60.2 (42.9)	<0.001 (<0.001)	
Prevalence of dyslipidaemia (Rx)	59.3 (5.9)	67.8 (11.3)	0.016 (0.007)	
Drug treatment of diabetes	79.6	96.1	<0.001	

Mean±SD or geometric mean (95% confidence intervals), or prevalence (%) unless other units given; NS = Non significant; ANCOVA = analysis of covariance adjusting for age, age of onset of diabetes, and duration of diabetes. Dichotomous variable described with χ^2 test p value. Rx= % receiving therapy of those with the condition. (ACR) albumin-to-creatinine ratio microalbuminuria= 3.5-30 mg/mmol (20).