Risk factors for erectile dysfunction in patients with cardiovascular disease

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Abstract

Objective: To examine the relationship between risk factors for cardiac disease and erectile dysfunction (ED) in men from Xi'an, China.

Methods: Participants were patients with cardiovascular disease who visited the Cardiovascular Medicine Department of Xi'an Jiaotong University First Affiliated Hospital between September 2011 and March 2012. Two hundred and fifty patients were issued with questionnaires and underwent a physical examination and blood test. Risk factors for ED were identified using univariate and multivariate analyses.

Results: In total, 222 participants returned valid questionnaires (89% response rate), underwent a physical examination and blood test, and were included in the study. The most common cardiovascular diseases were hypertension ($n = 142$; 64%), coronary heart disease ($n = 90$; 41%) and angina pectoris ($n = 78$; 35%). Most patients ($n = 144$; 65%) had two or more cardiovascular diseases. Age, smoking, body mass index, total cholesterol level, hypertension and the ratio of total cholesterol to high-density lipoprotein cholesterol were significantly associated with ED. Domestic location, level of education, participation in physical activity, diabetes and drinking alcohol were not associated with ED.

Conclusions: Common risk factors for cardiovascular disease are associated with ED in patients with cardiovascular disease. This study furthers understanding of the risk factors for ED in Chinese patients with cardiovascular disease and paves the way for further research into the prevention of ED.

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Introduction

Cardiovascular diseases are diseases of the heart and vascular system[1] that have similar aetiologies, clinical development and general treatment principles.[2] A prospective, population-based, cohort study conducted between 1985 and 2009 found the mortality rate of male city residents due to cardiovascular disease was >34%.[3] Internationally recognized major risk factors for cardiovascular disease include age, family history, smoking, obesity, unhealthy diet, lack of physical activity, dyslipidaemia, hypertension and diabetes.[4] These are also significant risk factors for cardiovascular disease in a Chinese population.[5]

Erectile dysfunction (ED) is diagnosed when a man cannot reach or maintain a full erection and is unsatisfied with his sex life.[6] Cardiovascular disease and ED often coexist, and they share common risk factors.[7] In ED, the damage that occurs to the penile artery within the corpus cavernosum is the same as that which occurs in the cardiovascular or endothelial system in cardiovascular disease; thus, ED is a complication of cardiovascular disease or is secondary to arterial disease.[8] The occurrence of ED is higher (31%) in patients with cardiovascular risk factors than in patients without cardiovascular risk factors (20%).[9]

The aim of this study was to examine the relationship between ED and risk factors associated with cardiovascular disease in men from Xi'an in China. This research provides data on the relationship of these interrelated diseases from a fast developing city in China.

Patients and methods

Patients

This study recruited patients with cardiovascular disease who visited the inpatient Department of Cardiovascular Medicine at the Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China between September 2011 and March 2012. The study sample size and power were not predetermined as this was a time-specified study. All participants had at least one of the following cardiovascular diseases: hypertension (controlled by medication); coronary heart disease (diagnosed by cardiac catheterization study and treadmill); arrhythmia (confirmed by electrocardiogram); angina or myocardial infarction. All participants had normal thinking ability, independent judgement, clarity of thought, ability to answer questions and were willing to co-operate in the study. Patients were excluded if they abused alcohol, were diagnosed with a psychological disease including psychological ED, had high lactation hyperlipidaemia, primary gonadal syndrome, a pituitary tumour, bilateral or unilateral cryptorchidism, testicular inflammation, severe anaemia, a prostate tumour, a genital mutilation deformity, a spinal cord injury, urinary genital mutilation, sexual maldevelopment, sex hormone disease, thyroid disease, an endocrine system disease such as hyperthyroidism, systemic lupus erythematosus, a connective tissue disease, a malignant tumour, a blood system disease, severe liver or renal damage or a sexually transmitted disease. Patients were also excluded if they were critically ill or were unable to independently complete the investigation.

Study procedures

Participants answered a questionnaire, providing information on their age (18–35 years, 36–49 years, 50–65 years or >65 years), marital status, level of education, economic situation, lifestyle, occupation, family, smoking status, alcohol consumption, level of physical activity and medical history (presence of hypertension, diabetes, hyperlipidaemia, coronary artery disease, arrhythmia, peripheral vascular disease and cerebrovascular illness). All participants underwent a general examination at which

blood pressure, height, weight, waist and hip circumference and other indicators were measured; routine blood and urine laboratory examinations were also performed to determine liver and kidney profile, total cholesterol level, ratio of total cholesterol to high-density lipoprotein (HDL) cholesterol, fasting plasma glucose level, random blood glucose level and blood glucose level 2 h after an oral glucose tolerance test. Body mass index (BMI) was calculated from height and weight data. Blood pressure was classified as normal, mild hypertension, moderate hypertension or severe hypertension according to the 2010 Guidelines for the Prevention and Treatment of Hypertension in China.[10] Diabetes mellitus (DM) was diagnosed according to the American Diabetes Association[11] as a fasting plasma glucose ≥7.0 mmol/l, a random blood sugar ≥11.1 mmol/l or glucose ≥11.1 mmol/l 2 h after an oral glucose tolerance test.

Erectile dysfunction was diagnosed if patients reported that they were unable to reach the erectile level necessary to perform sexual intercourse or had difficulty maintaining an adequate erection, and were unable to attain a satisfactory sex life for ≥6 months prior to the date of diagnosis. As part of the questionnaire, participants completed the International Index of Erectile Function 5 (IIEF-5).[12] ED was classified as severe if the IIEF-5 score was ≤7, moderate if the IIEF-5 score was 8–11, moderate to mild if the IIEF-5 score was 12–16 and mild if the IIEF-5 score was 17–21.

Ethics statement

Before the study began, the Xi'an Jiaotong University Ethics Committee approved the study plan, the method of obtaining informed consent from all participants and the statement of written informed consent. The study met all ethical principles for medical research involving human participants and did not invade the patients'

privacy. Written informed consent was obtained from all participants and all participants were provided with free access to the study results.

Statistical analyses

Statistical analyses were performed on the obtained data to calculate the significance of risk factors of cardiovascular disease on ED. Odds ratio and 95% confidence intervals for ED was calculated using Statistical Package for Social Sciences (SPSS® version l3.0; SSPS Inc, Chicago, IL, USA) software for univariate and multivariate analyses. Statistical significance was defined as a *P*-value <0.05.

Results

In total, 250 patients were enrolled in the study and issued with a questionnaire. Valid, completed questionnaires were recovered from 222 patients, giving a response rate of 89%. Twenty-two respondents (10%) were aged 18–35 years, 69 (31%) were aged 36–49 years, 73 (33%) were aged 50–65 years, and 58 (26%) were aged >65 years. The prevalence of cardiovascular disease was lower in the 18–35 year age group than in any other age group. Hypertension was the most prevalent cardiovascular disease (present in 142 of 222 patients; 64%), followed by coronary heart disease (90 of 222 patients; 41%) and angina pectoris (78 of 222 patients; 35%) (Figure 1). Over half of all patients (144; 65%) had more than one cardiovascular disease (*n* = 80 had two diseases and *n* = 64 had more than two diseases). The prevalence of hypertension and ED significantly increased with age (Tables 1, 2 and 3).

Univariate logistic regression analysis showed that age (odds ratio [95% confidence interval, CI]) 3.12 (2.04, 4.78); BMI 1.26 (1.11, 1.43); hypertension 1.72 (1.11, 2.66); coronary artery disease 2.24 (1.17, 4.28); total cholesterol level 1.77
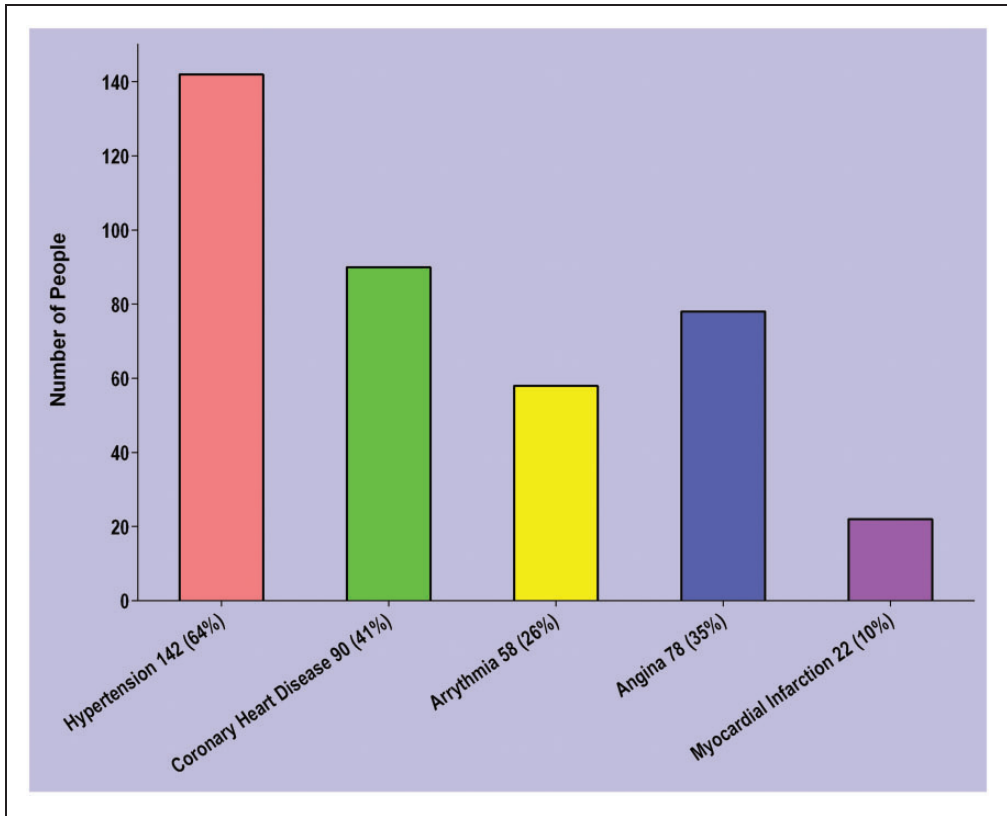
Figure 1. Distribution of individual cardiovascular diseases in male inpatients in the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China), participating in a study examining the relationship between erectile dysfunction and risk factors for cardiovascular disease.

(1.34, 2.34); ratio of total cholesterol to HDL cholesterol 1.72 (1.35, 2.18) and smoking 1.77 (1.20, 2.58) were significantly associated with increased odds of ED (Table 4). Residence, level of education, physical activity, alcohol consumption and DM were not significantly associated with ED. Multivariate logistic regression analysis confirmed that age, smoking, BMI, economic situation and the ratio of total cholesterol to HDL cholesterol were independent risk factors for ED (Table 5).

Discussion

This study was performed in men with cardiovascular disease, attending the First Affiliated Hospital of Xi'an Jiaotong University. The data obtained from hospitalized patients have high stability and accuracy, thus the use of hospitalized patients is an effective way to avoid information bias.[13] In addition, standardized survey processes were used, with uniform diagnostic criteria and reliable data filtering to reduce the risk of mixed bias and to increase the validity of these results.

A previous report suggested that the incidence of ED in patients with cardiovascular disease was similar in urban and rural areas.[14] With the ongoing development of the Chinese economy, the difference between urban and rural areas will continue to decrease, and cardiovascular disease will

Table 1. Distribution of hypertension classification[10] according to age group in inpatients at the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China), participating in a study examining the relationship between erectile dysfunction and risk factors for cardiovascular disease who completed the erectile dysfunction questionnaire and examinations.

Age group, years	Normal blood pressure	Hypertension		
		Mild	Moderate	Severe
18–35	15	5	2	0
36–49	44	17	6	2
50–65	14	43	15[a]	2
>65	7	17	30[a]	3

[a]Contingency table X^2 analysis; $P < 0.0001$.

no longer be a 'rich man's disease' specific to economically developed regions or cities.[15] A further study used multivariate logistic regression analysis to indicate that economic situation was an independent risk factor for ED in patients with cardiovascular disease.[16] People across China now have reasonable standards of living and leisure, and an increasing intake of high protein, high cholesterol foods, but undertake less physical activity. A low level of physical exercise, obesity and high blood cholesterol are all risk factors for ED.[17]

As societies develop, the average lifespan increases,[18] and the health-related quality of life as individuals age becomes of increasing concern.[19] ED shows a close relationship with old age.[20] The perception among the

Table 2. Classification of erectile dysfunction[12] according to age in inpatients at the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China).

Age group, years	Erectile dysfunction				
	None	Mild	Mild-to-moderate	Moderate	Severe
18–35	19	3	0	0	0
36–49	42	17	7	2	1
50–65	8	15	35[a]	12[a]	4
>65	5	0	18[a]	25[a]	9[a]

[a]Contingency table X^2 analysis; $P < 0.0001$.

Table 3. Distribution of erectile dysfunction (ED) classifications by hypertension diagnosis in inpatients at the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China).

Blood pressure	Erectile dysfunction				
	None	Mild	Mild-to-moderate	Moderate	Severe
Normal blood pressure	40 (50.0)	10 (12.5)	15 (18.8)	13 (16.3)	2 (2.5)
Mild hypertension	25 (30.5)	17 (20.7)	23 (28.0)	10 (12.2)	7 (8.5)
Moderate hypertension	8 (15.1)	8 (15.1)	19 (35.8)[a]	15 (28.3)[a]	3 (5.7)
Severe hypertension	1 (14.3)	0 (0.0)	3 (42.9)	1 (14.3)	2 (28.6)

Data expressed *as n* (%) of patients.
[a]Contingency table X^2 analysis; $P < 0.0009$.

Table 4. Univariate logistic regression analysis of the relationship between erectile dysfunction and risk factors for hypertension in inpatients at the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China).

Factor	Parameter	Standard error	Wald effect	Statistical significance	OR	95% CI	
						Lower	Upper
Age	1.14	0.21	27.48	*P* < **0.001**	3.12	2.04	4.78
Constant	−0.64	0.37	2.92	0.05	0.52		
Family	0.58	0.35	2.82	NS	1.79	0.91	3.52
Constant	0.31	0.60	0.28	0.60	1.37		
Education level	0.00	0.23	0.00	NS	1.00	0.63	1.58
Constant	1.29	0.57	5.11	0.02	3.64		
Physical activity	0.15	0.23	0.40	NS	1.16	0.74	1.82
Constant	1.06	0.41	6.82	0.01	2.88		
Smoking	0.57	0.19	8.65	*P* < **0.003**	1.77	1.21	2.58
Constant	0.55	0.29	3.61	0.06	1.73		
BMI	0.23	0.06	13.42	*P* < **0.001**	1.26	1.11	1.43
Constant	−4.12	1.47	7.92	0.005	0.05		
High blood pressure	0.54	0.22	5.89	*P* = **0.015**	1.71	1.11	2.66
Constant	0.93	0.21	19.55	0.00	2.53		
Coronary disease	0.80	0.33	5.91	*P* = **0.015**	2.24	1.17	4.28
Constant	0.97	0.20	24.16	0.00	2.65		
Arrhythmia	0.26	0.32	0.67	NS	1.30	0.69	2.43
Constant	1.21	0.18	43.22	0.00	3.35		
TC	0.57	0.14	16.06	*P* < **0.001**	1.77	1.34	2.34
Constant	−0.16	0.32	0.23	0.63	0.86		
TC/HDL	0.54	0.12	19.35	*P* < **0.001**	1.72	1.35	2.18
Constant	−0.15	0.30	0.24	0.62	0.86		

OR, odds ratio; CI, confidence interval; BMI, body mass ratio; TC, total cholesterol, HDL, high density cholesterol; NS, not significant.

general population is that as people age, decline in sexual function is a natural phenomenon. Although the news media provide excessive publicity about treatments available for sexually related diseases and sexual dysfunction, individuals who experience a decline in sexual function are embarrassed to seek medical help.[21]

In this study, most of the participants had at least two types of cardiovascular disease and a number of factors contributing to ED.[22] The prevalence of ED increased with age, supporting previous reports that the prevalence of ED is higher in individuals aged ≥50 years than in individuals aged ≤50

years.[23] Univariate and multivariate logistic regression analyses showed that age was a risk factor for ED. This supports previous studies in China and abroad, such as the Zhang Qingjiang survey of 2,226 men in three cities in China, which reported that the prevalence of ED was 15.6% in men aged ≤30 years, 24.5% in those aged 31–40 years, 26.1% in those aged 51–60 years, 43.4% in those aged 61–70 years and 65.3% in those aged >70 years.[24]

Smoking is a major risk factor for cardiovascular disease[25] and the incidence of hypertension, coronary heart disease and myocardial infarction is markedly higher in

Table 5. Multivariate logistic regression analysis of the relationship between erectile dysfunction and risk factors for hypertension in inpatients at the Department of Cardiovascular Medicine (Xi'an Jiaotong University First Affiliated Hospital, Xi'an, China).

Factor	Parameter	Standard error	Wald effect	Statistical significance	OR	OR 95% CI	
						Lower	Upper
BMI	0.35	0.11	9.62	*P* = **0.002**	1.41	1.14	1.76
Age	1.61	0.40	15.90	*P* < **0.001**	4.99	2.26	11.00
TC	−0.05	0.25	0.04	NS	0.95	0.58	1.56
TC/HDL	0.69	0.35	4.02	*P* = **0.045**	2.00	1.02	3.94
Smoking	0.75	0.30	6.33	*P* = **0.012**	2.11	1.18	3.77
Occupation	0.15	0.29	0.26	NS	1.16	0.66	2.05
Family	−1.17	0.74	2.48	NS	0.31	0.07	1.33
Level of education	−0.61	0.47	1.71	NS	0.54	0.22	1.36
Economic situation	1.03	0.47	4.91	*P* = **0.027**	2.80	1.13	6.98
Physical activity	0.36	0.42	0.73	NS	1.43	0.63	3.25
High blood pressure	−0.15	0.33	0.19	NS	0.87	0.45	1.66
Diabetes mellitus	−0.09	0.29	0.09	NS	0.92	0.52	1.63
Coronary disease	0.42	0.47	0.79	NS	1.52	0.60	3.83
Arrhythmia	−0.37	0.49	0.56	NS	0.69	0.26	1.81

OR, odds ratio; CI, confidence interval; TC, total cholesterol, HDL, high density cholesterol; NS, not significant.

smokers than in nonsmokers.[26] Nicotine causes vascular endothelial dysfunction, reduces sex hormone secretion, increases dysfunction of sperm, reduces the grade-b sperm count, causes abnormal sperm morphology and reduced motility, resulting in infertility.[27] Smoking also affects blood circulation and reduces genital blood flow, which can lead to sexual dysfunction.[28] Results from the present study indicate that smoking was an independent risk factor for ED. This is consistent with the results of existing research results in China and abroad. A meta-analysis by Tengs and Osgood showed that smoking was an important factor in ED,[29] and the Zhang Qingjiang study reported that the incidence of ED was 42.3% in individuals who smoked >20 cigarettes/day.[24] In this study, no statistically significant relationship was found between alcohol consumption and ED, which supports the report of Nicolosi et al.[30]

Obesity increases the risk of cardiovascular disease and can also affect the function of the endocrine system.[31] BMI is a simple height-to-weight ratio, which, with the body fat percentage content, has major relevance to CHD.[32] Obesity is an independent risk factor for coronary heart disease and stroke,[33,34] and a BMI ≥ 24 increases the risk of coronary heart disease in patients with high blood pressure, diabetes and dyslipidaemia.[35] Here, BMI was significantly associated with ED in patients with cardiovascular disease. There are several mechanisms by which obesity may increase the risk of ED. The high blood pressure, high blood sugar and high blood cholesterol associated with obesity will accelerate the formation of atherosclerotic plaques, which will have an effect on penile artery endothelium and blood flow dynamics.[36] Endocrine factors, such as reduced testosterone ketone secretion, and increased female hormone secretion can also impact ED.[37] Obesity

can also cause psychological inferiority and lead to poor social adjustment, which can cause psychological obstacles to sexual performance. In addition, a large amount of fat in the abdominal area and around the fat pad at the base of the penis can be an obstacle to sexual performance.[38]

Studies on the relationship between metabolism of blood lipids and erectile function are common both in China and in other countries.[39] Gholami et al.[40] concluded that hyperlipidaemia not only affects the vascular smooth muscle tissue of the penis, but also affects the peripheral cavernous nerve. Seftel et al.[41] reported that between 1995 and 2002, 42.4% of ED patients in the USA had hyperlipidaemia-related ED. A decrease in high density lipoprotein an elevation of total cholesterol/HDL are both correlated with ED[42] and are important risk factors for ED.[43] Results of the present study further indicate that the ratio of total cholesterol to HDL cholesterol is a risk factor for ED.

Hypertension may also be caused by mental and neurological factors,[44] problems with the renin-angiotensin system,[45] sodium retention (which leads to increased extracellular water and increased heart output volume),[46] or genetic factors.[47] Results of the present study showed that 76.1% of patients with essential hypertension had ED and that hypertension was a risk factor for ED.

Univariate logistic regression analysis showed that DM was not significantly associated with ED, which may have been due to the good control of blood sugar levels by the patients with DM involved in this study.

One limitation of this study was that the sample size and power were not predetermined.

In conclusion, this study confirms that risk factors for cardiovascular disease, i.e. economic situation, smoking, hypertension, coronary heart disease, diabetes and total cholesterol are also risk factors for ED. This study furthers our understanding of the risk factors for ED in Chinese patients with cardiovascular disease and paves the way for further research regarding prevention of ED.

Declaration of conflicting interest

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