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Original Article

Associated Factors for Erectile Dysfunction Occurrence in Patients with Coronary Artery Disease: A Cross-sectional Study

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Abstract

Background: Erectile dysfunction (ED) is associated with cardiovascular events, and a significant proportion of men with coronary artery disease (CAD) exhibit early signs of ED. Moreover, both of these disorders shared common risk factors in previous studies. This study was conducted to determine which risk factors and conditions in CAD patients might contribute to the occurrence of ED.

Methods: This analytical cross-sectional study was conducted in the North of Iran from October 2016 to September 2017. 316 patients with coronary artery disease were enrolled. Demographic information were collected using a checklist, and the International Index of Erectile Function (IIEF-15) questionnaire was used to determine the participant's ED status. Univariate and multivariate logistic regression were used to investigate associated factors.

Results: The mean age of the participants was 56.51±9.88 years. About 55.1% of the patients had ED. Moreover, the severity of CAD was independently associated with an increased risk of ED (OR=4.11, 95%CI=1.69-9.97), with patients having more than one involved coronary artery and greater coronary artery stenosis had a higher risk of developing ED occurrence (OR=3.74, 95%CI=1.72-8.09). Besides, age (OR=1.23, 95%CI=1.18-1.29) and BMI (OR=1.26, 95%CI=1.13-1.41) were independent predictors of ED occurrence in CAD patients.

Conclusion: Higher CAD severity, older age, and higher BMI were all independent predictors of ED occurrence in CAD patients. While, diabetes mellitus, dyslipidemia, and smoking were not independent risk factors, they could contribute to the development of ED when combined with other risk factors.

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Keywords ● Coronary artery disease ● Erectile dysfunction ● Risk factors ● Coronary angiography

What's Known

- A significant proportion of men with coronary artery disease exhibit early signs of erectile dysfunction.
- Both erectile dysfunction and coronary artery disease come from endothelial dysfunction.

What's New

- Patients with greater coronary artery stenosis have a higher risk of developing erectile dysfunction.
- Diabetes mellitus, dyslipidemia, and smoking might not be independent risk factors for erectile dysfunction in patients with coronary artery disease. However, they could increase the risk of developing erectile dysfunction when combined with other risk factors.

Introduction

Coronary artery disease (CAD) is a prevalent disorder that occurs due to aortic coronary artery stenosis.[1] This disease is one of the leading causes of mortality and disability worldwide,[1] accounting for about 20% of deaths in developed countries.[2] The most prevalent risk factors for developing CAD included older age, high body mass index (BMI), smoking, dyslipidemia,

hypertension, and diabetes mellitus.[3-5] The pathophysiology of CAD involves the formation of atherosclerotic plaque within the lumen of the blood vessels, resulting in compromised blood flow and inadequate oxygen supply to the myocardial tissue and other body organs.[6]

Erectile dysfunction (ED) is a prevalent disorder in men that interferes with men's normal sexual function. It is defined as an inadequate penile erection for acceptable sexual intercourse.[7] ED might result from several underlying pathogenic factors, including psychological, vascular, neurologic, urinary tract disorder, and behavioral issues.[8] However, vascular endothelial impairment is the primary cause, and vasculogenic ED caused by arterial or inflow impairment is the most common cause of ED.[9]

ED and CAD are interrelated because they both occur due to endothelial dysfunction.[10] Endothelium, as an inner vessel lining, plays an important function in managing blood flow and preventing the formation of plaques and its impairment can lead to the incidence of both disorders.[11] Furthermore, the correlation between ED and CAD could be attributed to the common risk factors they share.[12] Several studies demonstrated that ED and CAD could be predictors and risk factors for one another, and individuals with CAD were at a higher risk of developing ED and vice versa.[10, 12-14] This study aimed to evaluate the associated factors for developing ED in men with CAD and highlight the probable correlation between ED occurrence and CAD severity.

Patients and Methods

Study Design

This analytical cross-sectional study was conducted on 316 patients with CAD at the Dr. Heshmat Educational and Medical Center and Golsar Hospital (Rasht, Iran), from October 2016 to September 2017.

This study was approved by the Ethics Committee of Guilan University of Medical Sciences (code: IR.GUMS.REC.1395.166). This research was conducted according to the ethical standards of the Declaration of Helsinki in 1964. Prior to any intervention, written informed consent was obtained from all participants. Besides, the authors have ultimately observed ethical issues, including plagiarism, data fabrication, and double publication.

The inclusion criteria for this study were satisfaction for participation in the study, being married, aged between 30-70 years, having coronary artery stenosis based on angiography findings, being literate to fill out the first section of the International Index of Erectile Function (IIEF-15) questionnaire.

The exclusion criteria included incomplete or unreturned IIEF-15 questionnaires, urgent surgery for coronary artery bypass graft, any previous conditions that might affect sexual activity, such as liver cirrhosis, renal failure, thyroid impairment, anxiety, depression, history of pelvic, genital, or prostate surgery, and medications (such as beta-blockers, digoxin, diuretics, and opioids).

Data Collection Procedures

All patients in both hospitals underwent coronary angiography by a single cardiologist in accordance with the standard protocol. All the angiography films from both hospitals were collected and blindly assessed by two other cardiologists. In case of disagreement between the two cardiologists, the cases were reviewed by a third cardiologist, who reached a unanimous decision through discussion. Higher CAD severity was described as the presence of more than one involved coronary artery and a coronary artery stenosis percentage greater than 50% based on angiography findings. Demographic information, including age, history of any co-morbidities, smoking, alcohol consumption, and family history of heart diseases was obtained from the patients using a demographic characteristics questionnaire. The height and weight of the participants were measured, and their BMI was calculated. Dyslipidemia status was determined based on the laboratory data, including triglycerides, cholesterol, high-density lipoprotein (HDL), and low-density lipoprotein (LDL). The erectile function status was determined by the patient's self-report using the first part of the IIEF-15 questionnaire.

International Index of Erectile Function (IIEF-15)

The IIEF-15 is a self-reported questionnaire used to investigate erectile function (EF) and other sexual status in men. This scale consists of 15 items in five dimensions. The first dimension, which was used in this study, evaluated EF and developed to diagnose the occurrence and severity of ED. This dimension included six questions about ED (scored 0 to 5) with a score range of 0 to 30. The cut point in this study was set on 25, and a score of more than 25 was considered normal EF and less considered ED occurrence. The IIEF-15 questionnaire was validated linguistically in about 32 languages and was used in several studies.[15, 16]

Statistical Analysis

The data were analyzed using the IBM SPSS statistics software (version 24, IBM Corporation, Armonk, NY, USA). The Chi square test was used to compare the frequency distribution of ED and non-ED patients. The mean comparison of quantitative variables was performed using an independent *t* test. The study employed both univariate and multivariate binary logistic regression to investigate the risk factors associated with ED. P<0.05 was considered statistically significant.

Results

Out of the 320 patients who received the questionnaire, 316 individuals completed the questionnaires and returned them to us, resulting in a response rate of 98.8%. Results demonstrated all participants were men, with a mean age of 56.51±9.88 years and a mean BMI of 25.81±3.45 Kg/m^2. The majority of the participants had no family history of CAD, did not smoke or consume alcohol, and had no diabetes mellitus or dyslipidemia. The majority of

Table 1: Baseline demographic and clinical characteristics of the participants

Variable		Frequency N (%)
Sex	Male	316 (100)
Family history of CAD	No	242 (76.6)
	Yes	74 (23.4)
Smoking	No	209 (66.1)
	Yes	107 (33.9)
Alcohol Consumption	No	260 (82.3)
	Yes	56 (17.7)
Diabetes Mellitus	No	268 (84.8)
	Yes	48 (15.2)
Dyslipidemia	No	203 (64.2)
	Yes	113 (35.8)
Involved Artery Number	One	220 (69.6)
	More than one	96 (30.4)
Coronary Artery Stenosis	<50%	224 (70.9)
	>50%	92 (29.1)
Erectile Dysfunction	No	142 (44.9)
	Yes	174 (55.1)

N: Number; CAD: Coronary artery disease

Table 2: Frequency distribution of patients' characteristics according to erectile dysfunction status

Variable		Erectile Dysfunction		P value$^{\Phi}$
		NO (N=142)	Yes (N=174)	
		N (%)	N (%)	
Family history of CAD	No (N=242)	110 (45.5)	132 (54.5)	0.738*
	Yes (N=74)	32 (43.2)	42 (56.8)	
Smoking	No (N=209)	105 (50.2)	104 (49.8)	0.008*
	Yes (N=107)	37 (34.6)	70 (65.4)	
Alcohol Consumption	No (N=260)	119 (45.8)	141 (54.2)	0.521*
	Yes (N=56)	23 (41.1)	33 (58.9)	
Diabetes	No (N=268)	127 (47.4)	141 (52.6)	0.038*
	Yes (N=48)	15 (31.3)	33 (68.8)	
Dyslipidemia	No (N=203)	100 (49.3)	103 (50.7)	0.039*
	Yes (N=113)	42 (37.2)	71 (62.8)	
Involved Artery number	One (N=220)	109 (49.5)	111 (50.5)	0.013*
	>One (N=96)	33 (34.4)	63 (65.6)	
Coronary Artery Stenosis	<50% (N=224)	109 (48.7)	115 (51.3)	0.037*
	>50% (N=92)	33 (35.9)	59 (64.1)	
Variable		**Mean±SD**	**Mean±SD**	**P value$^{\Phi}$**
Age (year)		49.16±7.98	62.48±6.75	<0.001**
BMI (Kg/m^2)		24.70±3.17	26.72±3.42	<0.001**

N: Number; SD: Standard Deviation; CAD: Coronary artery disease; BMI: Body mass index; $^{\Phi}$P<0.05 was considered statistically significant. *Chi Square test was used for comparison of erectile dysfunction (Yes/No). **Independent *t* test

the studied patients had CAD, with one involved coronary artery and coronary artery stenosis of less than 50%. In terms of erectile dysfunction status, more than half of patients had ED (55.1%) (table 1).

Table 2 presents the frequency and percentage of patients with and without ED based on various demographic and clinical characteristics. According to the findings, the frequency of ED was higher among patients who smoked, had diabetes, dyslipidemia, more than one involved artery, and coronary artery stenosis greater than 50%. The results also showed that age and BMI were significantly associated with ED, with older age and higher BMI being associated with an increased risk of ED. The frequency of family history of CAD, and alcohol consumption according to ED status was not statistically significant, which indicated that these variables were not associated with ED in this sample population. The findings indicated that smoking, diabetes, dyslipidemia, the number of involved arteries, coronary artery stenosis, age, and BMI might all be essential factors to consider in the assessment and management of ED (table 2).

Table 3 presents the results of univariate and multiple logistic regression analyses for various risk factors associated with ED. The results indicated that diabetes, dyslipidemia, smoking, number of involved arteries, coronary artery stenosis, age, and BMI were significantly associated with ED in the univariate regression analysis. However, after adjusting variables for confounders in the multiple logistic regression analysis, only higher involved artery number, greater coronary artery stenosis, older age, and higher BMI remained significant independent predictors of ED. These results indicated that, with a one-year increase in age and a one Kg/m^2 increase in the BMI, the risk of developing ED increased by 1.23 95% CI (1.18-1.29) and 1.26 95% CI (1.13-1.41) times, respectively. In terms of CAD severity, the risk of developing ED was 3.74 times higher in patients with more than one involved artery than those with only one involved artery. Additionally, the risk of developing ED was 1.69 95% CI (1.02-2.79) times higher in patients with coronary artery stenosis greater than 50% than those with less than 50% stenosis. These findings suggested that the severity of CAD was associated with an increased risk of ED. In multiple logistic regression analysis, diabetes mellitus, dyslipidemia, and smoking were not found to be independent risk factors for ED. However, the univariate analysis showed that these risk factors, when accompanied by other risk factors, could increase the risk of developing ED. The odds ratio for developing ED was 2.39 95% CI (0.90-6.37) for diabetes mellitus, 2 95% CI (0.91-4.40) for dyslipidemia, and 1.30 95% CI (0.63-2.69) for smoking. These results suggested that while these risk factors might not be independent predictors of ED, they can contribute to its development when combined with other risk factors (table 3).

Discussion

The findings of the present study indicated that there was a significant association between CAD severity and ED. This finding was in line with the results of a previous study, which reported that CAD severity could result in a higher rate of ED occurrence.[12] Al-Daydamony and colleagues assessed the correlation between ED severity and CAD severity (three-vessel disease or left

Table 3: The correlation between demographic and clinical risk factors and ED occurrence using univariate and multivariate logistic regression

Risk Factors		Univariate Regression				Multiple Logistic Regression			
		95% CI		OR	P value$^{\Phi}$	95% CI		OR	P value$^{\Phi}$
		Lower	Upper			Lower	Upper		
Diabetes	Yes	1.02	3.81	1.98	0.041	0.90	6.37	2.39	0.079
	No (Ref)								
Smoking	Yes	1.18	3.09	1.91	0.008	0.63	2.69	1.30	0.466
	No (Ref)								
Dyslipidemia	Yes	1.02	2.62	1.64	0.039	0.91	4.40	2.00	0.083
	No (Ref)								
Involved artery number	>One	1.14	3.08	1.87	0.013	1.72	8.09	3.74	<0.001
	One (Ref)								
Coronary artery stenosis	>50%	1.02	2.79	1.69	0.039	1.69	9.97	4.11	0.002
	<50%(Ref)								
Age (Year)		1.16	1.26	1.21	<0.001	1.18	1.29	1.23	<0.001
BMI (Kg/m^2)		1.20	1.29	1.20	<0.001	1.13	1.41	1.26	<0.001

CI: Confidence interval; OR: Odds ratio; Ref: Reference, BMI: Body mass index; $^{\Phi}$P<0.05 was considered statistically significant.

main) and found that higher CAD severity was associated with more severe ED.[17] Moreover, a study conducted by Hamur and others revealed that the severity of ED can be independently associated with the degree of CAD.[18] According to Baharvand Ahmadi and others, the occurrence of ED was significantly higher in CAD men than in non-CAD individuals, as well as in CAD patients with higher involved vessel numbers.[19] These findings suggested that ED might be regarded as a predictor of early-stage CAD, and early detection of ED might enable the identification of patients at risk of CAD and timely intervention to prevent cardiovascular events.

The results of the present study also revealed that age and BMI were independent predictors of ED occurrence in CAD patients, older age and higher BMI resulted in a higher ED occurrence rate. This finding was consistent with the the findings of a study by Pauker-Sharon and colleagues, who reported age as an independent risk factor for ED.[20] In a study of CAD patients, the researchers found that the prevalence of ED increased as age increased.[21] A review also reported a correlation between older age and the prevalence of ED in various patients.[22] Obesity is one of the most serious public health issues worldwide,[23] and its correlation with ED was confirmed in several studies. Zhang and others reported that obesity and BMI>30 Kg/m^2 were independent risk factors for developing ED.[24] Another study found that BMI was a significant risk factor for ED.[25] Obesity and higher BMI were associated with an increased risk of CAD, and older age was a significant risk factor for CAD. Losing weight and maintaining a healthy weight could help the patients prevent ED and improve their overall health. Therefore, it is essential to use BMI to assess obesity, identify high-risk children and adolescents, provide to evidence-based obesity treatments, and address social determinants of health to prevent late outcomes.

According to the findings of the present study, diabetes mellitus, dyslipidemia, and smoking were not found to be independent risk factors for ED in CAD patients. However, when combined with other risk factors, they could contribute to the development of ED. According to a study by Kao and others, elderly diabetic individuals who continue to smoke had a significantly higher risk of experiencing diabetes-related erectile dysfunction.[26] Moreover, Bortolotti and colleagues found that smoking and diabetes could result in an increased risk of ED.[27] A study by Zhang and others also indicated that smoking and diabetes mellitus were significantly related to ED occurrence.[24] Parmar and others found that diabetic patients and those with higher cholesterol had a higher incidence of ED.[25] Overall, these studies indicated that diabetes mellitus, dyslipidemia, and smoking might not be independent risk factors for ED in CAD patients. However, they could increase the risk of developing ED when combined with other risk factors. Therefore, to effectively prevent or treat ED, all relevant risk factors for ED must be considered and addressed.

Therefore, it is critical to recognize the correlation between ED and CAD, as highlighted in the present study. Patients with CAD should be screened for ED, and also patients with ED should be evaluated for CAD. The presence of ED should be considered as a prompt comprehensive cardiovascular risk assessment.

Assessing the relationship between CAD severity and ED occurrence, which was studied rarely in previous studies, was a strength point of the present study. However, focusing solely on patients with CAD could be a limitation, and the results might not be generalizable to the general population or patients with other underlying disease conditions.

Conclusion

This study indicated that CAD severity was independently associated with an increased risk of developing ED. Patients with more than one involved coronary artery and greater coronary artery stenosis were at a higher risk of experiencing ED. Age and BMI were also independent predictors of ED occurrence in CAD patients. Although diabetes mellitus, dyslipidemia, and smoking were not found to be independent risk factors, when combined with other risk factors, they can contribute to the development of ED. This study provided valuable information on the predictors of ED occurrence in men with CAD. The findings of this study might help identify individuals who are at a higher risk of developing ED and might benefit from early intervention. Furthermore, this study might help us better understand the relationship between ED and CAD and lead to the development of innovative treatment strategies for both conditions.

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Authors' Contribution

A.H.M, F.M, M.H.M, M. N, M.GH, S.Z, T.H: Study concept and design, acquisition, and interpretation of data, drafting and critical revision of the manuscript. All authors have read and approved the final manuscript and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Conflict of Interest: None declared.

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