RESEARCH ARTICLE / Araştırma Makalesi

Effects of the Severity of Erectile Dysfunction on Aortic Stiffness

Erektil Disfonksiyonun Derecesinin Aortik Sertlik Üzerine Etkisi

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Abstract

Aim Aim of the present study was to evaluate the relationship between the degree of ED and aortic stiffness and whether cardiovascular risks increase in relation to the severity of ED. **(Sakarya Med J 2018, 8(1):1-6)**

Methods The study comprised 120 patients, who were diagnosed with ED at the urology outpatient clinics of our center, as the study group, and age- and gender-matched 30 volunteers as the control group. Erectile dysfunction in the study and the control groups were evaluated using the International Index of Erectile Dysfunction, the items of which are rated from 1 to 5 points. The parameters of aortic elasticity were regarded as the indicators of aortic function.

Results When the echocardiography findings and the parameters of aortic elasticity were compared between the patient and control group, Distensibility (cm2/dyn−1/103) was 3.7±1.42 in the patient group and 4.6±2.2 in the control group, whereas aortic strain (%) was 4.9±2.6% in the patient group and 7.6±3.2% in the control group (p=0.009). When the degree of ED was evaluated according to the parameters of aortic elasticity, there was a significant difference between the control group and the ED group as well as between the control group and mild ED group, in terms of aortic stiffness. Furthermore, there was a significant difference between the mild and severe ED groups.

Conclusion The degree of aortic stiffness increases with the increasing severity of ED. This finding suggests that cardiovascular risks would be higher with increasing severity of ED.

Keywords Bioabsorbable scaffold, percutaneous coronary intervention, stent

Öz

Amaç Bu çalışmanın amacı, Erektil Disfonksiyon'un(ED) şiddeti ile aort sertliği arasındaki ilişkiyi ve ED şiddetine bağlı olarak kardiyovasküler risklerin artıp artmadığını değerlendirmektir. **(Sakarya Tıp Dergisi 2018, 8(1):1-6).**

Yöntem Çalışmamız; merkezimiz üroloji polikliniğinde ED tanısı alan 120 hasta ve kontrol grubu olarak yaş ve cinsiyet olarak uygun 30 gönüllü grubunu içermektedir. Çalışmada ve kontrol gruplarındaki ED derecesi; 1 ile 5 puan arasında derecelendirilen Uluslararası Erektil Disfonksiyon İndeksi (IIEF-5) kullanılarak saptandı. Aortik elastikiyet parametreleri aort fonksiyonunun göstergeleri olarak kabul edildi. Aort sistolik ve diastolik indeksleri aortik sistolik ve diyastolik çaplarının beden kitle indeksine oranı ile elde edildi.

Bulgular Ekokardiyografik bulgular ve aort elastikiyeti parametreleri hasta ve kontrol grubu arasında karşılaştırıldığında, hasta grubunda Distensibilite (cm2/dyn−1/103) 3.7 ± 1.42, kontrol grubunda 4.6 ± 2.2 saptanırken aortik strain (%) hasta grubunda% 4.9 ± 2.6, kontrol grubunda% 7.6 ± 3.2 idi (p = 0.009). ED derecesi aortik elastikiyet parametrelerine göre değerlendirildiğinde, kontrol grubu ile hafif derecede ED grubu arasında aort sertliği açısından anlamlı fark vardı. Ek olarak, hafif ve şiddetli ED grupları arasında da aort sertliği açısından anlamlı fark saptandı; Ancak, hafif ED ile orta ED, Orta ED ile şiddetli ED arasında anlamlı bir farklılık yoktu.

Sonuç ED'li hastalarda aort sertliği artmaktadır. Buna ek olarak, aort sertliği ED'nin şiddeti arttıkça artmaktadır. Bu bulgu, ED'nin şiddeti arttıkça kardiyovasküler risklerin daha yüksek olacağını düşündürmektedir.

Anahtar Kelimeler Biyoeriyebilen iskelet, perkütan koroner girişim, stent

Introduction

Erectile dysfunction (ED) is defined as the inability to develop or maintain penile erection sufficient to have sexual intercourse[1]. Coronary artery disease (CAD) and ED are two important disorder that have common risk factors such as diabetes mellitus (DM), hypertension, dyslipidemia, obesity, smoking, and metabolic syndrome[2-3-4]. The presence of these common risk factors is associated with increased oxidative stress, endothelial cell damage, and endothelial dysfunction[5-6]. Endothelial dysfunction and arterial stiffness are two different components for arterial diseases with a similar pathophysiologic background. Nitric oxide (NO) released from the endothelium has been shown to contribute to arterial compliance and distensibility[7]. Arterial stiffness comprises two inter-related components; a structural component involving collagen elastin fibers and related molecules in the arterial media[8] and a dynamic component expressed as the tonus of smooth muscle cells dependent on vasoactive substances released from the endothelium[9]. Aortic stiffness can be expected to be affected in the presence of endothelial damage, either due to chronic inflammation or an increase in the hemodynamic workload. Aortic stiffness is an important risk factor for cardiovascular mortality and morbidity[10].

Due to the similarity between the pathophysiologic mechanisms, the aim of present study was to evaluate the relationship between the degree of ED and aortic stiffness and whether cardiovascular risks increase in relation to the severity of ED.

Materials and Methods

Study Population

The study comprised 120 patients, who were diagnosed with ED at the urology outpatient clinics of our center, as the study group, and age- and gender-matched 30 volunteers as the control group. Patients with segmental wall defect, left ventricular ejection fraction (LVEF%) of less than 55%, a past history of coronary revascularization due to a known coronary artery disease, positive effort test, left branch block and heart rhythm other than sinus rhythm on electrocardiography, New York Heart Association (NYHA) class III-IV, and patients with peripheral vessel disease, severe valvular disease, permanent pacemaker and those with a history of valvular surgery or history of other surgical interventions (i.e. radical retropubic prostatectomy, cystectomy), patients with polyneuropathy due to a neurologic disease, chronic alcohol users, patients with psychosis and depression, and apparent diabetes mellitus (fasting blood glucose ≥126 mg/dL) were excluded from the study. Each patient underwent an effort test performed according to the Bruce protocol. Erectile dysfunction in the study and the control groups were evaluated using the International Index of Erectile Dysfunction (IIEF-5), the items of which are rated from 1 to 5 points. After calculating the total scores according to this form, scores of 22-25 points indicated no ED, 17-21 points indicated mild ED, 12-16 points indicated mild-moderate ED, 8-11 points indicated moderate ED, and 1-7 points indicated severe ED[11]. The patients that achieved scores corresponding to mild-moderate ED according to IIEF-5 were included in the moderate ED group. The local ethics committee approved the study.

Transthoracic Echocardiography

Echocardiographic examination was performed using commercially available echocardiography device (Philips, iE33, the Netherlands) as per the recommendations of the American Society of Echocardiography[12]. Each patient was examined in the left lateral decubitus position at rest by an

experienced operator. The patients were continuously monitored with electrocardiography during the procedure. Left ventricular (LV) and left atrial (LA) diameters and LV wall thickness were measured in the parasternal long axis views in all patients. Left ventricular ejection fraction (LVEF) was calculated using the Simpson's method in the apical 4-chamber views and 2-chamber images

Following routine echocardiographic examination, recordings of the ascending aorta were obtained 3 cm above the aortic valve using M-mode images. Aortic diameter was calculated by measuring the distance between anterior and posterior inner walls of the aorta during systole and diastole. Systolic diameter of the aorta (AS) was measured during the complete opening of the aortic valve. Diastolic diameter of the aorta (AD) was measured at the peak of the QRS complex on EKG recordings. The measurements were performed in three consecutive beats and the mean value was recorded.

The parameters of aortic elasticity were regarded as the indicators of aortic function. Aortic systolic (AS) and diastolic (AD) indices were acquired by the ratio of aortic systolic and diastolic diameters to the body mass index. Using these indices, the following parameters of aortic elasticity were calculated[13-14]:

- Pulse pressure (mmHg) = systolic blood pressure - diastolic blood pressure
- Aortic strain (%) = 100. (AS - AD) / AD
- Distensibility (cm2.dyn−1.10-3) = 2. (AS - AD) / pulse pressure. AD

Statistical Methods

The data were analyzed using SPSS version 20.0. The Student's t test or Mann-Whitney U test were performed to examine the presence of a significant difference between the measurements of the groups. Pearson or Spearman correlation coefficients were used to test the significance of the linear relationship between the continuous variables. Categorical variables were compared using chi-square test. Continuous variables were expressed as mean ± S.D., and a p value less than 0.05 was considered statistically significant.

Results

The study group comprised 120 patients diagnosed with ED and 32 volunteers as the control group (the mean age was 51±9 years in the ED group and 48±5 years in the control group, p>0.05) (Table 1). When clinical and laboratory findings of the patients and the control group were evaluated, the mean heart rate was 74±13 beat/min and 75±9 beat/min, respectively (p>0.05). The mean systolic blood pressure was 132±18 mmHg in the patient group and 127±16 mmHg in the control group (p=0.032). The mean diastolic blood pressure was 86±8 beat/min in the patient group and 79±8 beat/min in the control group (p=0.044, Table 1). The mean LVEF was 65±7% in the patient group and 64±8% in the control group (p>0.05). Distensibility (cm2/dyn−1/103) was 3.7±1.42 in the patient group and 4.6±2.2 in the control group, whereas aortic strain (%) was 4.9±2.6% in the patient group and 7.6±3.2% in the control group (p=0.009, Table 2). When the degree of ED was evaluated according to the parameters of aortic elasticity, there was a significant difference between the control group and the ED group as well as between the control group and mild ED group, in terms of aortic stiffness. Furthermore, there was a significant difference between mild and severe ED groups; however, there was no significant difference between moderate ED and mild and severe ED (Table 3).

Table 1. Clinical and laboratory findings of patients and control groups

Variable	Patient group (n=120)	Control group (n=32)	P value
Age (year)	51±9	48±5	>0.546
BMI (kg/m2)	30±4	29±3	>0.382
Hypertension (n,%)	70(%58.3)	18(%56.2)	>0.765
Smoking (n,%)	34(%28.3)	11(%34.3)	>0.338
LDL (mg/dl)	138±40	132±42	>0.429
HDL (mg/dl)	47±7 >0.05	45±7.5	>0.684
TG (mg/dl)	175±68	165±82	>0.543
Heart rate (atım/dk)	74±13	75±9	>0.652
Systolic blood pressure (mmHg)	132±18	127±16	0.032
Diastolic blood pressure (mmHg)	86±8	79±8	0.044
IEFF-5 Score	11±3.2	21.5±3.4	<0.001
Antihypertensive drug therapy, n (%)	57(%47.5)	15(%46.8)	>0.746

BMI= Body mass index; LDL=Low density lipoprotein; HDL=High density lipoprotein; TG=Triglyceride; IEFF-5= International Index of Erectile Function-5

Table 2. Echocardiographic findings and aortic elastic properties in patient and control groups

Variable	Patient group(n:120)	Control(n:32)	P value
LVEF (%)	65±7	64±8	>0.654
LVEDD (cm)	4.8±0.6	4.9±0.5	>0.245
LVESD(cm)	3.4± 0.3	3.2±0.4	>0.654
LVMI (g/m2)	115±29.2	116± 28.6	>0.428
IVSD(cm)	1.1± 0.18	1.08± 0.26	>0.421
PWD(cm)	1.08 ± 0.1	1.05± 0.16	>0.246
Aortic systolic diameter (cm)	3.3±0.3	2.9±0.4	0.015
Aortic diastolic diameter (cm)	3.0±0.4	2.8±0.3	0.034
Distensibility (cm2/dyn−1/103)	3.7±1.42	4.6±2.2	0.022
Aortic strain (%)	4.9±2.6	7.6±3.2	0.009
E(m/s)	0.88 ± 0.22	0.74 ± 0.14	>0.215
A(m/s)	0.64± 0.17	0.82± 0.12	0.042
E/A ratio	1.25 ±0.28	0.89 ± 0.22	<0.001

LVEF=Left ventricular ejection fraction; LVEDD=Left ventricular end diastolic diameter; LVESD=Left ventricular systolic diameter; LVMI=Left ventricular mass index; IVSD=Interventricular septum diameter; PWD=Posterior wall diameter; E/A: Ratio between diastolic early (E) and late diastolic mitral inflow (A) velocities

Table 3. Control group and Erectile dysfunction grade and Aortic elastic properties

	Control grup (n=32)	ED (n=120)	Mild ED (n=52)	Moderate ED (n=38)	Severe ED (n=30)
Aortic strain(%)	7.6±3.2[a]	4.9±2.6[a]	4.7±2[b]	5.2±1.1[d]	5.7±1.2[c]
Aortic distentibity	4.6±2.2[a]	3.7±1.42[a]	3.5±1.2[b]	3.8±0.8[d]	4.0±1.1[c]

[a] P < 0.05 versus control group and ED group.
[b] P < 0.05 versus control group and mild ED group.
[c] P < 0.05 versus mild group and severe ED group
[d] P>0.05 versus modarate group and severe ED, mild ED group

Discussion

When the results deduced from this study are summarized, there is an increased aortic stiffness in patients with ED. In addition, the degree of aortic stiffness increases with the increasing severity of

ED. This finding suggests that cardiovascular risks increase with the increasing severity of ED. This finding may show that aortic stiffness could be used to predict cardiovascular events in patients with ED, and may further indicate which patients require more detailed examination for CAD and more intensive treatment for secondary protection depending on the severity of ED.

ED is currently recognized as a risk marker for acute and chronic cardiovascular events in the absence of a known CAD and is considered to be a predictor of all-cause mortality in males, cardiovascular mortality, coronary events, stroke and peripheral artery disease, and early predictor of vascular disorders[15].

ED and CAD share common risk factors16-17 and pathophysiological mechanisms involving endothelial dysfunction[18-19]. Previous studies have addressed ED as a precursor of CAD[18-19-20]. Furthermore, ED often occurs 2-5 years after the manifestation of CAD21. In addition, studies have shown higher all-cause mortality and cardiovascular mortality in males with ED[22-23]. The studies also showed that in most patients ED could be the first sign of systemic cardiovascular disease[24]. Increased aortic stiffness and decreased elasticity are considered to indicate unfavorable effects of atherosclerosis[25-26]. Various studies have shown a relationship between coronary artery disease, risk factors and increase in aortic stiffness and decrease in elasticity[27- 28-29]. Decreased aortic elasticity and increased aortic stiffness are known to be affected by aging[29], atherosclerosis[30], DM[31], hypertension[32], and hypercholesterolemia[33]. When carefully evaluated, these risk factors also increase the risk of developing ED. Therefore it is not surprising to find that in the present study aortic stiffness increased with the increasing severity of ED. However, this becomes more important considering the fact that patients with CAD and DM were not included in the present study. The results of the present study suggest that elastic properties of the aorta are closely related to ED, CAD, and risk factors.

A recent study on patients without a known cardiovascular disease reported a relationship between increased aortic stiffness and an increased rate of cardiovascular events in patients with ED and suggested that ED could be used to predict cardiovascular disease along with other cardiovascular risk factors[15]. Another study followed patients with ED and without a known CAD for an average 4.7 years and reported a relationship between increased aortic stiffness and cardiovascular events[34]. The present study showed that the severity of aortic stiffness increased with increasing severity of ED independently from these risk factors even in the absence of apparent DM and CAD and in patients with negative effort tests. In conclusion, aortic stiffness increases in these patients regardless of the severity of ED and thus increases the risk of CAD and other cardiovascular events. We therefore suggest that aortic stiffness could be used in detailed assessments of patients with ED for the presence of CAD. In addition, the degree of aortic stiffness increases with the increasing severity of ED. This finding suggests that cardiovascular risks would be higher with the increasing severity of ED.

The limitations of the study were small number of patients particularly in subgroup analysis and also presence of a silent CAD cannot be ruled out, even if effort tests were performed and the patients received different antihypertensive agents.

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