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Association between Ankle-Brachial Index and Erectile Dysfunction

Bianca Aki Ishiy Ozima[1], Pedro Paulo Polotto[2], Thiago Litaiff Padilha[2], João Paulo Pretti Fantin[2], Fernando Nestor Fácio Júnior[2], Luís Cesar Fava Spessoto[2]

[1]Medicine Student, Medicine School in São José do Rio Preto (FAMERP), São José do Rio Preto, SP, Brazil
[2]Department of Urology, Hospital de Base-FAMERP, São José do Rio Preto, SP, Brazil

Abstract: The aim of this research was to investigate the clinical application of the ankle-brachial index (ABI), used to diagnose PAD, in patients with ED, taking into account demographic and socioeconomic characteristics, and possible associations of the degree of ED with the ABI and with risk factors for ED. A prospective quasi randomized (in order of arrival) cross-sectional study was performed of patients with ED from the region of São José do Rio Preto, SP, Brazil, regardless of race. ED was classified as mild (grade 1), moderate (grade 2) or severe (grade 3) using the international index of erectile function (IIEF). Patients were submitted to an assessment of the ABI with values below 0.9 indicating PAD. Of the patients studied (n = 30), nine (30%) had mild (grade 1), 14 (46.7%) moderate (grade 2) and seven (23.3%) severe ED (grade 3). Most patients were between 60 and 70 years old, had waist circumferences above the ideal (86.7%), were married or in a stable relationship (80%), and had at least six years of schooling (54%). The clinical application of ABI in patients with ED showed the absence of PAD. Regarding risk factors for ED, most patients were hypertensive and sedentary. There was no significant association between the degree of ED and the ABI, or risk factors for ED.

Keywords: erectile dysfunction, peripheral arterial disease, cardiovascular risk factors

Introduction

Erectile dysfunction (ED) is characterized by a persistent inability of a man to achieve or maintain an erection sufficient for satisfactory sexual intercourse (National Institutes of Health, 1993). The impact of ED in the life of the individual is of significant importance, as it affects his self-esteem and quality of life.

According to Hannan et al. (2009), ED is a public health problem affecting about 100 million men worldwide. On studying 1290 North American men aged between 40 and 70 in the region of Massachusetts, Feldman et al. (1994) found a prevalence of 52% for different degrees of ED.

The Study of Sexual Behavior (ECOS) that investigated erectile function in three regions of Brazil found a rate of 46.2% of ED (Moreira et al., 2001). Abdo et al. (2006), on investigating the prevalence of ED and associated risk factors in a sample of the population (2862 over 18-year-old men) reported a prevalence of 45.1%.

Among the risk factors most commonly correlated to ED are systemic arterial hypertension (SAH), diabetes mellitus, heart disease, smoking, excessive alcohol consumption, obesity, sedentary lifestyle, lower urinary tract symptoms, prostate cancer, hypogonadism, depression, aging, dyslipidemia, metabolic syndrome, periodontitis, asthma and sleep disorders (Spessoto et al., 2016; 2010; Al Naimi et al., 2014; Kaya et al. 2015; Sanjay et al., 2015; Hoyos et al., 2015; Randrup et al., 2015; Maia et al., 2016; Li & Siegrist, 2012). Although the association between ED and aging is attributed to increased oxidative stress and endothelial dysfunction of vessels in the penis, the molecular mechanisms involved are not fully understood (Johnson et al., 2011).

On investigating the association between ED and PAD using the International Index of Erectile Function (IIEF) and ankle-brachial index (ABI), respectively, Polonsky et al. (2009) found that ED is an independent predictor of PAD and increased

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Luís Cesar Fava Spessoto (Correspondence)
lcspessoto@gmail.com
+55 17 3201 5700; fax: +55 17 3229 1777

severity of ED is associated with an increased prevalence of PAD.

The ABI is a non-invasive vascular examination that determines the ratio between the highest systolic blood pressure (SBP) in the ankle (dorsalis pedis or posterior tibial arteries) and the highest SBP in the brachial arteries (Murabito et al., 2003).

ED is related to endothelial dysfunction that, in turn, denotes the early detection of heart disease (Miner et al., 2014). Thus, ED represents a general marker of vascular disease and is a predictor of cardiovascular morbidity (Randrup et al., 2015); it is estimated that ED appears 2 to 5 years prior to a cardiac event (Schwartz & Kloner, 2011).

No studies on the clinical application of the ABI in patients with ED treated in urology clinics were found in the literature. Moreover, from a clinical point of view this research is justified as patients with ED may have asymptomatic PAD and cardiovascular morbidities. Therefore, early identification of cardiovascular risk factors may help to avoid cardiovascular events.

The objective of this research was to study the clinical application of ABI in patients with ED, considering demographic and socioeconomic characteristics of patients, the association between ABI and the degree of ED, and the association between the degree of ED and risk factors for ED.

Patients and Methods

This study was approved by the Research Ethics Committee of the Medicine School in São José do Rio Preto (FAMERP - CAAE: 44495615.9.0000.5415). All patients were informed about the study and confirmed their willingness to participate by signing an informed consent.

A prospective quasi randomized (in order of arrival) cross-sectional study was performed of patients with ED from the region of São José do Rio Preto, SP, regardless of race. These individuals were evaluated between August and November 2015.

Patients were treated in the Urology Outpatient Clinic of Hospital de Base (HB) in São José do Rio Preto. Data including information regarding sociodemographic details, anamnesis and clinical status were recorded on a form.

All patients complaining of ED were included. Demographic (age and geographical origin) and socioeconomic data (marital status, education, occupation and religion) were analyzed. Under 18-year-old, and illiterate patients and those with cognitive impairment were excluded.

Initially, the patients' general medical history was investigated and they completed the IIEF to classify the degree of ED as mild, moderate or severe. According to the IIEF, mild ED (grade I) is characterized when the sum of the points is between 17 and 24, moderate (grade II) is between 10 and 16 points and severe (grade III) is when the score is less than 10 points.

The waist circumference was measured at the umbilicus (Lohman et al., 1998). In the absence of a universally accepted cutoff for the abdominal circumference, it was decided to employ the one used in research on the association between the waist circumference and risk to health (normal: <88 cm, high: >88 cm) (Janssen et al., 2004).

Patients were submitted to a general physical examination and the ABI was calculated. Values of the ABI below 0.9 indicate PAD (Murabito et al., 2003).

Relative frequencies and descriptive statistics (mean, median, standard deviation, minimum and maximum) were used for statistical analysis. Comparisons between quantitative variables (sedentary lifestyle, smoking, hypertension, diabetes mellitus and BMI) were achieved using the two-sample t test. One-way analysis of variance (ANOVA) was used to assess the association between the degree of ED and quantitative variables (age, waist circumference and ABI), and Pearson's chi-square test was applied to investigate any correlation between the degree of ED and qualitative variables (sedentary lifestyle, smoking, hypertension, diabetes mellitus, marital status, religion and education). The level of significance was set for p-values <0.05. All analyzes were performed using the R program version 3.2.2 (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the patients studied (n = 30), nine (30%) had mild (grade 1), 14 (46.7%) moderate (grade 2) and seven (23.3%) severe ED (grade 3).

The mean age of the patients with ED was 58.17 years. The mean waist circumference (105.98 cm) shows that patients were above the ideal (88 cm) however the mean ABI (1.1) indicates that patients had not developed PAD. The descriptive statistics of these variables are shown in Table 1.

Table 1 - Descriptive statistics of quantitative variables of 30 patients with erectile dysfunction.

Variable	mean	SD	median	range
age (years)	58.17	8.75	59	40-74
waist (cm)	105.98	15.04	103	80-143
ABI	1.1	0.21	1.1	0.58-1.5

SD: standard deviation; ABI: ankle-brachial index

Table 2 shows the percentage distribution of qualitative variables. Most patients (80%) were married or in a stable relationship, had at least six years of schooling (54%) and were Catholics (76%), sedentary (70%) and hypertensive (60%).

Table 2 - Distribution of qualitative variables of 30 patients with erectile dysfunction.

Variable	n	%
Marital status		
married/stable relationship	24	80
others	6	20
Schooling*		
incomplete junior school	13	46
completed junior school	15	54
Religion*		
catholic	22	76
others	7	24
Sedentary lifestyle		
yes	21	70
no	9	30
Smoker		
yes	8	27
no	22	73
Hypertension		
yes	18	60
no	12	40
Diabetes mellitus		
yes	10	33
no	20	67

* data from some patients were missing in the hospital records

Using Student's t-test for independent samples, no significant associations were found between ED and a sedentary lifestyle, smoking, hypertension or diabetes mellitus (Table 3).

Table 3 - Comparison of clinical variables of 30 patients with erectile dysfunction using the t test for two independent samples.

Variable	n	mean	SD	P*
sedentary lifestyle	21	1.072	0.191	0.345
non-sedentary lifestyle	9	1.160	0.237	
smoker	8	1.043	0.229	0.244
non-smoker	22	1.119	0.117	
hypertensive	18	1.122	0.206	0.457
non-hypertensive	12	1.063	0.209	
diabetic	10	1.113	0.067	0.793
non-diabetic	20	1.091	0.047	

SD: standard deviation *Student's t-test

Moreover, no associations were found between ED and the patient's age, waist circumference or ABI (one-way ANOVA - Table 4), or between ED and hypertension, diabetes mellitus, smoking, sedentary lifestyle, marital status or religion (Pearson's chi-square test - Table 5).

Table 4 - Mean, standard deviation (SD), values of F test in the one-way ANOVA of the variables age, waist circumference and ankle-brachial index (ABI) according to the erectile dysfunction.

Degree of ED	mean ± SD			F	P*
	1	2	3		
age (years)	56.7 ± 9.3	58.8 ± 7.2	58.8 ± 11.7	0.18	0.84
waist (cm)	97.7 ± 7.0	111.7 ± 15.7	105.2 ± 17.8	2.64	0.09
ABI	1.1 ± 0.2	1.1 ± 0.2	1.1 ± 0.3	0.23	0.80

* ANOVA

Table 5 - Association of hypertension, diabetes, smoking and sedentary lifestyle on the degree of erectile dysfunction (in percentage).

Degree of ED	Hypertensive	Non-hypertensive	Total	P
1	27.8	33.3	30	
2	55.6	33.3	46.7	0.43
3	16.7	33.3	23.3	
Total	100	100	100	
Degree of ED	Diabetic	Non-diabetic	Total	P
1	20.0	35.0	30	
2	50.0	45.0	46.7	0.66
3	30.0	20.0	23.3	
Total	100	100	100	
Degree of ED	Smoker	Non-smoker	Total	P
1	25.0	31.8	30	
2	50.0	45.5	46.7	0.94
3	25.0	22.7	23.3	
Total	100	100	100	
Degree of ED	Sedentary	Non-sedentary	Total	P
1	23.8	44.4	30.0	
2	52.4	33.3	46.7	0.5
3	23.8	22.2	23.3	
Total	100	100	100	
Degree of ED	Married	Not married	Total	P
1	29.2	33.3	30.0	
2	45.8	50.0	46.7	0.91
3	25.0	16.7	23.3	
Total	100	100	100	
Degree of ED	Catholic	Other	Total	P
1	27.3	42.9	31.0	
2	45.5	42.9	44.9	0.67
3	27.3	14.3	24.1	
Total	100	100	100	
Degree of ED	<6 years schooling	>6 years schooling	Total	P
1	38.5	26.7	32.1	
2	46.2	40.0	42.9	0.53
3	15.4	33.3	25.0	
Total	100	100	100	

hypertension: Chi-square Pearson = 1.693; DF = 2
diabetes: Chi-square Pearson = 0.821; DF = 2
smoking: Chi-square Pearson = 0.130; DF = 2

sedentary lifestyle: Chi-square Pearson = 1.391; DF = 2
marital status: Chi-square Pearson = 0.188; DF = 2
religion: Chi-square Pearson = 0.795; DF = 2
schooling: Chi-square Pearson = 1.260; DF = 2

Discussion

The results of this research show that the majority of patients have moderate ED, are between 60 and 70 years old and have an excess of abdominal fat. The ABI of the patients with ED showed an absence of PAD. In respect to risk factors for ED, most patients were hypertensive and sedentary. There was no significant association of the degree of ED with ABI, or with risk factors for ED.

In this series, the mean age of patients with ED ranged from 40 to 74 years. As age is a risk factor for ED, patients with this disorder must be followed up by an expert, because there is a probability that the degree of ED will worsen as the age increases (Abdo et al., 2006; Maia et al., 2016).

In the current study, the results show that in general the waist circumference of patients was high (mean: 105.98 cm) and thus they are at high risk of developing diseases caused by an excess of abdominal fat. Several studies have reported that the waist circumference is associated with cardiovascular and metabolic diseases (Despres et al., 1990). Besides the development of these diseases, excessive abdominal fat is associated with ED (Janiszewski et al., 2009).

Several studies show an association between PAD and ED (Spessoto et al., 2010; 2016). Polonsky et al. (2009), on studying 690 patients and characterizing patients with PAD as those with ABI $\leq$ 0.9, proved that ED is an independent predictor of PAD. The current study investigated the benefit of the clinical application of ABI in patients with ED. Most patients had normal ABIs (> 0.9) and hence did not have PAD. However, it is important to remember that the greatest benefit, prevention of the development of PAD, is achieved by monitoring the ABI together with guidance on risk factors related to PAD and ED.

This research found, in accordance with the literature, that one of the most common cardiovascular risk factors in patients with ED was SAH (60%) (Spessoto et al., 2010; 2016; Maia et al., 2016). As increased blood pressure is an independent and continuous risk factor for cardiovascular disease (Lewington et al., 2002), this data suggests that hypertension may be involved in the onset or worsening of ED.

The current study shows that most patients with ED do not exercise. The literature shows that physical inactivity is a risk factor for cardiovascular disease and also for ED (Prasad & Das, 2009; Kratzik et al., 2009). A survey of 1156 men in Boston, Massachusetts, showed that physical activity reduces the risk of ED (Derby et al., 2000).

Although this study did not show a significant association between the degree of ED and risk factors for ED, this fact was already known in the international scientific community. On using the IIEF-5 questionnaire in a study of 1052 patients with ED from Qatar, Al Naimi et al. (2014) demonstrated that diabetes mellitus, hypertension, coronary artery disease and hyperlipidemia are risk factors for ED.

Conclusion

Most patients have moderate ED, are between 60 and 70 years old and have an excess of abdominal fat. The clinical application of ABI in patients with ED does not necessarily identify PAD in these patients. Most patients are hypertensive and sedentary; these are considered risk factors for ED. There was no significant association of the degree of ED with ABI, or with risk factors for ED.

Conflicts of Interest: none

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