■Original Article

Ankle brachial index measurement in first-line health care: A simple and inexpensive but very valuable method

Birinci basamak sağlık hizmetinde ayak bileği brakial indeks ölçümü: Basit, ucuz ama çok değerli bir yöntem

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ABSTRACT

Aim: Peripheral arterial disease (PAD) affects more than 30 million people in the World. Ankle Brachial Index (ABI) is a simple method to detect PAD. Patients are referred to vascular surgery department with prediagnosis of PAD, but many of them are mis-diagnosed. The aim of this study was to determine the importance of ABI in first-line health care.

Material and Methods: From December 2017 – November 2018; 108 patients were referred from first-line health care units to our department. Patients were analyzed retrospectively regarding risk factors, ABI and real diagnosis.

Results: 24 patients (22,22%) were diagnosed PAD. Mean ABI in PAD and non-PAD patients was 0.545±0.193 and 0.996±0.093, respectively.

Conclusion: The use of ABI measurement in first-line health care could avoid the mis-diagnosis of PAD and related loss of time and additional costs.

Key words: ankle brachial index; first-line health care; peripheral arterial disease

ÖZ

Amaç: Periferik arter hastalığı (PAH) dünyada 30 milyondan fazla insanı etkileyen bir hastalıktır. Ayak Bileği Brakiyal İndeksi (ABI), PAH'ı saptamak için basit bir yöntemdir. Hastalar PAH öntanısı ile vasküler cerrahi bölümüne yönlendirilir, ancak çoğunda teşhis doğrulanamamaktadır. Bu çalışmanın amacı, birinci basamak sağlık hizmetlerinde ABI ölçümünün önemini belirlemektir.

Gereç ve Yöntemler: Aralık 2017 – Kasım 2018 tarihlerinde 108 hasta birinci basamak sağlık biriminden bölümümüze yönlendirildi. Tüm hastalar risk faktörleri, ABI ve gerçek tanı ile ilgili olarak retrospektif analiz edildi.

Bulgular: 24 hastada (% 22,22) PAH tanısı doğrulanmıştır. PAH ve PAH olmayan hastalardaki ortalama ABI sırasıyla 0,545±0,193 ve 0,996±0,093 idi.

Sonuç: Birinci basamak sağlık hizmetlerinde ABI ölçümünün kullanılması, PAH'ın yanlış teşhisini ve bununla ilgili zaman kaybını ve ek maliyetleri önleyecektir.

Anahtar kelimeler: ayak bileği brakial indeksi; birinci basamak sağlık hizmeti; periferik arter hastalığı

Introduction

Peripheral arterial disease (PAD) is a disease manifested by constriction or obstruction of the arteries from the abdominal aorta to the distal arteries as a result of progressive atherosclerosis. Peripheral artery disease is an important health problem with increasing incidence. It is estimated that over 30 million people in the world are affected by PAD.

PAD may be asymptomatic or may be seen with atypical symptoms, so there may be skips or delays in the diagnosis, and therefore it is generally estimated to be less than real prevalence [1]. The prevalence of peripheral arterial disease increases with age. The prolongation of life expectancy also led to an increase in prevalence of PAD compared to previous years [1].

Clinical manifestations of peripheral arterial disease are caused by significant obstruction of

vessels. At first, pain in the legs occures when walking (claudicatio intermittens), but later on at rest. Systolic blood pressure ankle-brachial index (ABI) is primarily used in the clinical diagnosis of peripheral arterial disease. The ankle-brachial index is a non-invasive screening method for the general population and shows 95% sensitivity and 99% specificity in PAD's diagnosed by angiography. The ankle-brachial index is considered normal between 1.0 and 1.3. The presence of ABI ≤0.9 is diagnostic for PAD [1]. Highly calcified arteries in diabetes and kidney disease can cause abnormally high ABI values [1]. Low ABI is an important predictor for cardiovascular morbidity and mortality. Table-1 demostrates ABI interpretations. Risk factors for peripheral arterial disease are male gender, advanced age, smoking habit, hyperlipidemia, hypertension, diabetes mellitus and metabolic syndrome [2,3].

Table-1: ABI Interpretation	
ABI	
0.9 – 1.3	Normal
<0.9	ischemia
<0.6	Severe ischemia
>1.3	Severe medial calcification

Early diagnosis of PAD is important because of several risky consequences. Asymptomatic patients can be detected by ABI measurement, which is a non-invasive method, and undesirable results can be prevented. Furthermore, it is necessary to know the risk factors of PAD and take precautions for those who can be modified.

ABI is simple and inexpensive and an increase of ABI measurement in first-line healthcare providers would prevent accumulation of patients in vascular surgery clinics, especially of those who are not PAD patients. Based on this idea, the following study was planned.

Material and Methods

Patients with leg pain and prediagnosed as PAD referred to our clinic in the last year (December 2017-November 2018) were evaluated retrospectively. Patients were evaluated in terms of age, gender, history of cardiovascular disease, hypertension, hyperlipidemia, diabetes mellitus, previous cerebrovascular accident, obesity, smoking habit and sedentary life habit. Patients whose ABI value was taken and confirmed by Doppler ultrasonography were included in the study.

Hypertension was defined as systolic blood pressure ≥140 mmHg, diastolic blood pressure ≥90 mmHg or using antihypertensive medication. Patients with total cholesterol-low density lipoprotein ratio over 5 and / or cholesterol-lowering drugs were considered to have hyperlipidemia. The obesity criterion was accepted as a BMI > 26 kg/m2. Local ethics committee approved the study and informed consent was obtained from participant(s)

Ankle Brachial Index Measurement

Brachial artery (BA) systolic pressure was measured with a sphygmomanometer from both upper extremities in the supine position. In both lower extremities, systolic pressure measurements were taken from both the dorsalis pedis artery (DPA) and posterior tibial artery (PTA) with a 8 MHz vascular portable Doppler device. ABI value was determined with this formula:

$$ABİ = \frac{\text{Higher value of DPA and PTA systolic pressures}}{\text{Higher value of BA systolic pressure}}$$

Results

108 patients were included in the study. The mean age of these patients was 61.7 ± 9.9 and 94 patients (87.03%) were male. Diagnosis of the patients was confirmed by ABI measurement and Doppler ultrasonography. Accordingly, 24 of 108 patients were diagnosed as peripheral arterial disease (PAD) (22,22%). Eight of these patients underwent surgical or interventional treatment, while the other patients were followed up with medical treatment. The data were examined in two groups, PAD patients and non-PAD patients (non-PAD). Mean age of PAD group was 63.6 ± 7.6 (56-76 years), the mean age was 61.1 ± 10.4 years in the non-PAD group (32-82 years) (p> 0.05) and the male patient ratio was 83.3% in the PAD group and 88.1% in the non-PAD group. Only one patient had a history of stroke (non-PAD group). The rate of patients with a history of cardiovascular disease was significantly higher in the PAD group (33.3% versus 4.7%). The presence of hypertension, diabetes mellitus, smoking habits and sedentary lifestyle were higher in the PAD group, whereas the rate of obesity and hyperlipidemia was higher in the non-PAD group. In the PAD group, the ABI value was 0.545 ± 0.193, and was 0.996 ± 0.093 in the non-PAD group, the difference was statistically significant (p <0.001). The data are demostrated in Table-2.

Tablo 2: Patient Results

	PAD	non-PAD	p
Number	24 (22,22%)	84 (77,78%)	>0.005
ABI	0.545 ± 0.198	0.995 ± 0.093	<0.001
Male (n)	20 (%83.3)	74 (%88.1)	>0.05
Age	63.58 ± 7.81	61.17 ± 10.44	>0.05
Previous cardiovascular disease	4 (%33.3)	2 (%4.7)	<0.05
Hypertension	11 (%91.6)	3 (%7.1)	<0.05
Hyperlipidemia	2 (%16.6)	23 (%54.8)	<0.05
Diabetes mellitus	9 (%75)	15 (%35.7)	<0.05
Stroke	0 (%0)	1 (%2.4)	>0.05
Obesity	1 (%8.3)	8 (%19.0)	<0.05
Smoking habbit	9 (%75)	(25 (%59.5)	<0.05
Sedantery life style	11 (%91.6)	20 (%47.6)	<0.05

Statistical analysis

Statistical analysis was performed using the Windows-based SPSS (Statistical Package for the Social Sciences) 23 statistical package program. For the variables indicated by measurement mean ± standard deviation (X ± SD); for the variables specified by counting the percentage (%) value is calculated. In this study, independent groups which were not distributed normally were evaluated with Mann-Whitney U Test.

Discussion

Most of cardiovascular events have been reported in individuals without any previous clinical signs [4]. In order to prevent these events, it is important to follow people with risk factors to diagnose them early. For this purpose, risk factors such as smoking, HT, total and HDL cholesterol levels and diabetes as well as predictors such as C-reactive protein (CRP) are recommended to be examnined [5]. 72% of PAD patients had coronary artery disease [6]. The measurement of ankle brachial index has also been reported as a method of providing useful information in predicting the risk of cardiovascular disease [5,7]. When peripheral arterial disease is asymptomatic, it can be detected by controlling the lower extremity pulses during physical examination and by ABI measurement. When the ankle-brachial index is <0.9, it is abnormal and indicates PAD [2].

The high ankle-brachial index (> 1.3) was reported to have a role in the diagnosis of peripheral arterial disease because of its sensitivity and specificity and it should be evaluated as PAD [8]. In a study of 1762 patients who presented with vascular disease symptoms, ABI measurements were performed, 64.6% had low, 27% had normal, and 8.4% had high (≥1.3) ABI values. It was observed that the distribution did not show any features in terms of gender, and as the age increased, the prevalence of low ABI values increased. The prevalence of high ABI was not related to age. In the same study, it was emphasized that 62.2% of patients with high ABI had PAD, and the clinical significance of this condition was not clear since those with high ABI values were excluded from the PAD studies [8]. Poredos and Jug [9] reported that 952 patients in the high-risk group of cardiovascular diseases had symptomatic atherosclerosis in 821 (86.2%) and at least two risk factors were present in asymptomatic patients. In the same study, PAD was observed in 42% of patients with coronary artery disease (CAD) and there was no significant difference in risk profile in CAD and PAD groups.

In the United States, at age 40 and above the prevalence of

PAD (ABI <0.9) was 5% and 8.7% for borderline PAD (ABI 0.90-0.99) [9]. The prevalence of PAD at age 60 and above was found to be 12.2% [10]. The prevalence for low-normal ABI values (1.00-1.09) and normal ABI values (1.10-1.29) was reported to be 27.8% and 54.8%, respectively [11]. The prevalence of peripheral arterial disease and borderline PAD increased with age. In the same study, smoking, hypertension, diabetes and obesity were higher in the ABI group. These findings are consistent with the results of this publication except obesity. Obesity was found to be low in the PAD group. In a study that examined 33,629 patients with peripheral arterial disease, it was found that diabetes was associated with 29% and increased all-cause mortality [12]. In this study, the rate of diabetes was significantly higher in the PAD group.

Smoking habit, diabetes, hypertension and hyperlipidemia were positively associated with PAD in people over 40 years of age representing the general population in the United States [13]. In Spain, the prevalence of PAD detected by ABI in the age of 40 and over was found to be 9.7% in women and 11.4% in men [14]. Smoking, hypertension, hypercholesterolemia and diabetes were positively correlated with PAD. More than 91% of patients with peripheral artery disease have at least one of the risk factors for cardiovascular disease [14].

In this study, male gender, history of cardiovascular disease, hypertension, diabetes, smoking habit and sedentary lifestyle seem to be directly related to the presence of PAD. However, hyperlipidemia and obesity were not associated with PAD. The aim of this study was not to determine the risk factors for PAD. To identify risk factors, the number of patients included in the study should be higher. However, the aim of the study was not to determine the risk factors but to evaluate the patients who applied to the family physician or the first-line health providers. All patients were admitted with the complaint of leg pain and were referred to the vascular surgery clinic with a prediagnosis of PAD. PAD was confirmed in 22,22% and 77,78% not, which were suggested to apply to a non-vascular clinic. Since peripheral arterial disease can be asymptomatic or may be seen with atypical symptoms, it may be difficult to diagnose and delays in diagnosis could happen [1], and it may be difficult to establish a correct initial diagnosis for first-line health providers. Antza C. et al. emphasized the importanec of early diagnosis for PAD [15]. Ankle-brachial index measurement is a simple and inexpensive diagnostic method. The spread of this diagnostic method seems to be very useful in making a correct diagnosis. According to a study by Pearson et al., the time required for ABI measurement was 3-11 minutes, on average 5 minutes [16]. The diagnosis of PAD would be confirmed and delay in diagnosis would be prevented, as well as accumulation of non-PAD patients in vascular clinics.

Conclusion

The use of ABI measurement in first-line health care could avoid the mis-diagnosis of PAD and related loss of time and additional costs.

Declaration of conflict of interest

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