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The use of ankle brachial pressure indices in a cohort of black African diabetic patients

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ABSTRACT

Background: Peripheral arterial disease is very common in patients with diabetes, but it remains grossly under-recognized in this type of patients. Ankle brachial index (ABI) is a simple, non-invasive and reproducible method for detection and improving risk stratification. However, the sensitivity appears to be lower in diabetic patients and, false 'high' readings occur because of the arterial calcification of the vessel media which render the vessels incompressible.

Materials and methods: The study evaluated the prevalence of a low ABI < 0.9 in diabetic patients in a hospital-based cross sectional observational study. The study has been registered.

Results: The prevalence of peripheral arterial disease in diabetics with ABI < 0.9 was 18%. The majority (77%) of responders were asymptomatic with mild PAD (ABI 0.7–0.9). Age > 60 years, hypertension (systolic BP > 140 mmHg) and presence of foot ulcer were identified as independent risk factors. 22 participants (4.4%) of the 500 had ABI greater than 1.3 but were excluded in the analysis.

Conclusion: The prevalence of PAD in diabetics measured by the ABI index was low and the majority in our setting had mild PAD and were asymptomatic. ABI could be used in patients with diabetes, but values should be interpreted with precision, according to the clinical situation as higher values are common.

1. Introduction

It is estimated that 170 million individuals have diabetes in the world and it is projected to rise to 360 million by 2030 [1]. Atherosclerotic vascular disease is probably present in all patients with long duration diabetes, and, is responsible for up to 70% of deaths in non-insulin dependent diabetes mellitus (NIDDM) [1,2]. In addition to diabetes accelerating atherosclerosis, the premenopausal protection from vascular disease is lost in female diabetic patients and peripheral vascular disease may be 20 times more common in diabetes [2] Although PAD is very common in patients with diabetes, it remains grossly under-recognized in this population because neuropathy masks the pain of intermittent claudication [3]. PAD is associated with a high risk of lower extremities amputation and an important marker of generalize atherosclerosis. It has a linear relationship with coronary artery disease [4]. The same risk factors also operate and include smoking, hypertension, dyslipidaemia, abnormal fibrinolysis and altered platelet function [5,6]. Doppler-derived arterial pressure measurements should confirm the presence of arterial disease. The Ankle brachial index (ABI) is the ratio of the ankle systolic pressure to the brachial systolic pressure which is 1.0 or more in normal subjects [7,8]. A low ABPI also indicate a significantly raised relative risk of death from cardiovascular disease [9]. However, the degenerative dystrophic calcification of the media especially common in the major lower limb arteries of the elderly and in patients with diabetes cause false 'high' readings. In these patients toe pressure measurements may be of value [10].

Africa has the lowest rate of diabetes but has the highest rate of undiagnosed patients and thus complications. The prevalence of diabetes is 5.7% in urban Cameroon, W/Africa, but 70% of the population remain undiagnosed [11,12]. In addition, the progression of asymptomatic peripheral arterial disease to claudication has been less widely studied. In the Edinburgh Artery study 15% of those with major, and 7% of those with minor asymptomatic disease developed intermittent claudication in a five-year period [13]. Despite the 'false' high readings with diabetics, the objective of our study was to evaluate the relationship between ABI and cardiovascular (CVS) risk factors in a hospital cohort of adult patients with diabetes. The aim was to evaluate the prevalence and implications of a low ABI < 0.9 in an African diabetic population, and the associated risk factors.

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2. Methods

A hospital-based cross-sectional observational study of diabetic patients aged 20 years and above, was carried out in the National Centre for diabetes and hypertension of the Yaounde Central hospital in Cameroon, W/Africa between January and March 2016. The minimum sample size was obtained from the Cochrane formula [14]: ($N = z^2$ p(1-p)/d^2) where n is estimated sample size; z is the standard normal variate and for 95% confidence interval it is 1.96; p is the prevalence of PAD in patients with CVS risk factors at the Yaounde General Hospital 2014 reported by Menangal et al. [15] as 16.7%; d the tolerated sampling error (5%). Using the above formula, n (1.96)2 (0.167)(0.833)/(0.05)2 the minimum sample size was 214 diabetic patients. A convenient consecutive non-probability sampling method was used to enroll those who met the inclusion criteria for the study. The inclusion criteria were 1) patients above 20 years with diabetes and being followed up for at least 12 months, 2) those who consented to the study. The exclusion criteria were 1) those who had deep vein thrombosis (DVT) diagnosed by a positive Homan's sign or a history of DVT, 2) patient who had undergone vascular surgery to lower limbs, 3) those with diagnosed vascular disease, 4) severe terminally ill patients who could not tolerate the ABI measurement procedures, 5) those who did not consent to the study. Of the 510 diabetic patients approached, 7 patients who denied consent and 3 deep vein thrombosis (DVT) patients were excluded from the study. Ankle Brachial pressure Index (ABI) measurements were done for all patients. To measure the Doppler ankle pressure, a sphygmomanometer cuff placed around the ankle was inflated to a suprasystolic level and then slowly deflated. The onset of blood flow detected by the Doppler probe equals the systolic blood pressure. Both the posterior tibial and dorsalis pedis arteries were interrogated and the highest pressure noted. If neither was heard a search was made for the peroneal artery behind the fibula or around the lateral malleolus. ABI values were categorized into three groups; (a) those with ABI < 0.9 were considered as having PAD, (b) those with ABI > 0.9 but < 1.3 were considered as having normal ABI and thus no PAD, (c) those with ABI > 1.3 were considered as having incompressible vessels and excluded from the analysis as required further investigations such as the toe-brachial index. 22 (4.4%) patients with ABI > 1.3 were excluded from further analysis. 478 patients with diabetes were administered a pretested questionnaire containing socio-demographic, clinical and paraclinical characteristics. The mean age of participants was 59 years and majority were of the female gender (65%). 99% of participants had type 2 diabetes and the mean duration of diabetes was 8 years. Cardiovascular risk factors were evaluated in all participants. Fasting blood sugar and urinalysis for proteinuria were performed. HbA1c, creatinine, HDL-cholesterol, LDL-cholesterol, total cholesterol and triglyceride levels were noted from the patients' files. The Edinburgh's Claudication Questionnaire (ECQ) [16] was administered to those with ABI < 0.9 and 106 patients responded (Table 3). A data entry form was created in EPI-INFO version 7.0. The data was analyzed using 95% confidence interval with a P-value of 0.05 considered statistically significant. The study has been registered.

3. Results

Using a cut of value of ABI < 0.9, out of 478 participants in the analysis, 86 had ABI < 0.9 giving a prevalence of 18%. Of the 106 who responded to the Edinburgh claudication questionnaire 77% were asymptomatic with mild PAD (ABI 0.7–0.9). 23% reported claudication (Table 3) (14% below the knee, 6% above the knee (thigh) and 3% both above and below the knee). 37 (22%) males and 49 (16%) females had PAD as determined by the ankle-brachial index (ABI). In the bivariate analysis using a simple Chi square, PAD was associated with aging (p = 0.033), ethnicity (P 0.04), duration of diabetes (p = 0.006), past history of hypertension (p 0.009), history of MI (p = 0.022), presence of foot ulcers (p= 0.004), high systolic blood pressure (p = 0.011), visceral obesity (p = 0.001), proteinuria (p= 0.001), low levels of HDLc (p < 0.001) and high levels of LDLc (p = 0.022) (Tables 1, 4–7). In multivariate analysis using logistic regression, PAD was independently associated with age > 60 years (p = 0.004), OR 2.03, CI: 1.24–3.34), presence of foot ulcers (p = 0.002, OR 12.03, CI: 2.29–63.13) and systolic BP > 140 mmHg (p = 0.005, OR 1.96, CI: 1.21–3.16) (Table 2). 22 (4.4%) participants of the 500 had ABI greater than 1.3 and were excluded in the analysis.

Table 1
Bivariate analysis of socio-demographic risk factors for PAD.

	PAD n (%)	NON-PAD n (%)	TOTAL	P-Value
Age				
> 60	59 (68.60)	203(51.79)	262(54.81)	**0.033**
< 60	27(31.40)	189(48.21)	216(45.19)	
Gender				
Male	37 (43.02)	128(32.65)	165(34.52)	0.619
Female	49 (56.98)	264(67.35)	313(65.48)	
Occupation				
Unemployed	67 (77.91)	295(75.26)	362(75.10)	0.809
employed	19(22.09)	97(24.74)	116(24.90)	
Educational level				
High	52(60.47)	200(51.02)	252(52.72)	0.820
Low	34(39.53)	192(48.98)	226(47.28)	
Ethnicity				
Coastal tropical forest people	8(9.30)	25(6.38)	33(6.9)	**0.040**
Others	78(90.70)	367(93.62)	445(93.10)	

Bold indicates statistically significant p-value.

Table 2
Logistic regression of risk factors of PAD.

Risk Factor	p-value	95% Confidence interval	Odds Ratio
Age(≥60 vs. < 60 years)	*0.004*	*1.23–3.34*	*2.03*
Ethnicity coastal tropical forest people vs. Others	0.625	0.4–3.14	0.083
Duration of Diabetes (≥10 vs. < 10 years)	0.234	1.01–5.21	1.70
Past History of Hypertension (Yes vs No)	0.737	3.24–10.52	4.42
Myocardial Infarction (Yes vs No)	0.999	1.67–8.21	2.3
Presence Of Foot Ulcer(s) (Yes vs No)	**0.0002**	**2.29–63.13**	**12.03**
Taking Antiplatelet drugs (Yes vs No)	0.084	0.32–2.11	0.54
Systolic BP(mmHg) (≥140 vs < 140 mmHg)	**0.005**	**1.21–3.16**	**1.96**
Visceral Obesity (Yes vs No)	0.761	1.04–3.92	2.10
Creatinine (> 1.2 vs ≤ 1.2 mg/dL)	0.778	0.21–3.1	0.65
Proteinuria (Yes vs No)	0.061	1.42–4.60	2.55
HDLc (< 50 vs ≥ 150 mg/dL)	0.899	0.64–1.32	0.92
LDLc (> 100 vs ≤ 100 mg/dL)	0.498	2.23–9.52	5.10

Bold indicates statistically significant p-value.

Table 3
The Rutherford classification of participants with PAD.

Grade	Categories/ stages/ABI	Description	Number of participants	Percentage (%)
0	0 (ABI 0.91–1.3)	asymptomatic	66	76.64
1		Claudication	20	23.26
	1(ABI 0.70–0.9)	Mild(> 200 m)	16	80
	2(ABI 0.40–0.69)	Moderate (100–200 m)	4	20
	3(ABI < 0.4)	Severe (< 100 m)	0	0
II	4	Rest pain	0	0
III	5	Minor tissue loss	0	0
IV	6	Major tissue loss	0	0