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The Prevalence of Lower Extremity Peripheral Artery Disease among Adults with Type 2 Diabetes Mellitus Attending a Teaching Hospital in Ghana

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Abstract: ***Background: Peripheral artery disease (PAD) indicates generalized atherosclerosis and thus carries a very high risk for cardiovascular morbidity and mortality and is usually extensive and severe when associated with diabetes. Ankle Brachial Index (ABI) is a single, non-invasive and reliable bedside method for diagnosing the presence and severity of PAD. Objectives of the study was to estimate the prevalence of PAD in the lower limbs among adult type 2 diabetic clients and to assess any associations between PAD and selected clinical factors like sex, age, hypertension and duration of diabetes. Methods: A cross-sectional descriptive study was conducted between January, 2015 through April, 2015 among patients with diabetes attending the diabetes clinic at Cape Coast teaching hospital, Ghana. A pre-coded questionnaire was used to collect data by face to face interview, and ABI measurement was done for each client. An ABI of <0.9 was considered diagnostic of PAD. Results: A total of 200 adult clients with diabetes with a female predominance (71.5% females; 28.5% males) participated in the study. Majority were within the 50-59 and 60-69 age groups. Majority (34.5%) of the clients reported duration of their diabetes diagnosis between 5-10 years. The prevalence of PAD among the study clients on the right and left lower limbs were 17.5% and 18.0% respectively with preponderance in female clients. Of these, 22/35 (62.9%) had mild PAD on the right leg and 24/36 (66.7%) on the left leg whiles 13/35 (37.1%) had moderate PAD on the right leg and 12/36 (33.3%) on the left leg respectively with no severe disease noted. PAD was associated with duration of diabetes (p<0.05). Majority (88.5%) of the clients had hypertension co-morbidity. Conclusions: PAD is common among adult type 2clients with diabetes in Ghana and early screening and treatment by medical professionals needs to be emphasized to help lower subsequent morbidity and mortality and systemic atherosclerotic diseases.***

Keywords: Peripheral artery disease, Type 2 diabetes, Ankle brachial index, Ghana, Cape Coast

1. Introduction

Peripheral artery disease (PAD) is a condition characterized by atherosclerotic occlusive disease of the lower extremities[1] and is one of the macrovascular complications highly prevalent in adult diabetic patients. Diabetes and smoking are the strongest risk factors for PAD, and other well known risk factors of PAD are advanced age, hypertension and hyperlipidemia[2]. Also in people with diabetes, the risk of PAD is found to increased by age, duration of diabetes, and presence of peripheral neuropathy[1].

In Ghana, the prevalence rate of diabetes mellitus in adults is 3.3 per cent[3] and the prevalence of PAD worldwide has been estimated at between 4.5% and 29%[4], and in Sub Saharan Africa, the prevalence of PAD varies from 1.7-52.5%[5-8]. A study in Nigeria reported evidence of PAD in 54% of diabetic patients with foot complications[9], whilst another study from Tanzania found PAD in 21% of diabetic patients[10].

Screening for PAD is important for two main reasons. Firstly, the majority of patients with PAD are asymptomatic, even in symptomatic patients atypical symptoms are common[11,12]. Secondly, PAD indicates generalized atherosclerosis and thus carries a very high risk for cardiovascular morbidity and mortality[13,14]. PAD is also usually extensive and severe when associated with diabetes[15].Therefore, early screening, detection and optimal management of asymptomatic PAD among the adult diabetic clients would significantly lower subsequent morbidity and mortality and systemic atherosclerotic diseases.

Ankle Brachial Index (ABI), which is the ratio of ankle to brachial systolic blood pressure is a simple, non-invasive and reliable bedside method for diagnosing the presence and severity of PAD. It is 95% sensitive and 100% specific compared to the gold standard angiography[16]. American College of Cardiology /American Heart Association (ACC/AHA) also recommend measurement of ABI in symptomatic patients as a diagnostic criterion[17]. An ABI of less than 0.9 is diagnostic of PAD. In Ghana, there are no studies examining the burden of PAD and related clinical factors in adult diabetic clients. We therefore conducted this descriptive cross sectional study among adult diabetic clients attending the diabetic outpatient clinic of Cape Coast teaching hospital, Ghana to determine the prevalence of lower extremity PAD among type 2 diabetic clients. The objectives of the study were to 1) to estimate the prevalence of PAD in the lower limbs among adult type 2 diabetic clients and 2) to assess any associations between PAD and selected clinical factors like sex, gender, hypertension and duration of diabetes.

2. Materials and Methods

Study setting

This study was conducted at the diabetic outpatient clinic of Cape Coast teaching hospital, Cape Coast, Ghana. The hospital is a tertiary referral hospital and the diabetes specialist clinic is where new and old diabetic patients are reviewed once a month, and there are 3 clinic days in a week and an average of 40 old patients and 2 new patients are seen every clinic day. The clinic is run by two medical officers, one physician specialist, five nurses and two dietitians.

Study design
The study was a cross-sectional prospective survey that was conducted between January, 2015 through April, 2015.

Study population and sampling procedure
The study population consisted of type 2 adult diabetic clients aged >40 years who are registered patients at the clinic. Clients excluded from the study included those below 40 years of age, clients who have smoked or consumed tea or coffee hours prior to their clinic appointment, those with lower limb amputations and those who withheld consent for the study. Systematic random sampling was used to recruit clients into the study. This was done by choosing the 3rd patient as they were triaged during their review clinic day. In case the client declined to participate in the study or was ineligible, the next one was selected. This was done during every clinic day until the desired sample size was attained. A convenience sample size of 200 clients was used in this study.

Data collection
A pre-coded questionnaire were used to collect the study information which included: socio- demographic characteristics (age, gender, educational level, occupation, religion, ethnicity) and clinical history (age at initial diagnosis of DM, duration of DM, smoking history and history of hypertension). The questionnaire was administered to the study participants after offering informed consent by the same trained research assistant by face to face interview during their routine clinic reviews.

Measurement of ABI
For all patients, we measured the brachial systolic blood pressure after a 5-minute rest in the supine position, using a mercury sphygmomanometer (Model number 1002 by Riester, Germany). To measure the brachial systolic blood pressure, the brachial artery was palpated and identified in each arm. The brachial systolic blood pressure was then determined by applying the blood pressure cuff with the lower edge at 2.5 cm above the ante-cubital fossa and inflated to at least 30 mmHg above the level at which radial pulsation disappeared so as to ensure complete collapse of the brachial artery. The cuff deflation proceeded slowly at no greater than 2 mmHg per second. As the cuff was being deflated slowly the research assistant listened for the first korotkoff sound with a littman Stethoscope (3M Littmann Cardiology III Stethoscope, U.S.A) placed over the brachial artery in the ante-cubital fossa. The brachial systolic blood pressure was measured in both arms, two times in each arm and the mean was calculated for each arm and the higher value is used as the denominator of the ABI.

Ankle systolic blood pressures for each lower limb was also measured using the same mercury sphygmomanometer while using a standardized Doppler ultrasonic device (8 MHz; Edan™ SonoTrax® ED 120114321; Shekou, China) to accentuate the sounds over the posterior tibial and dorsalis pedis arteries. At each ankle, the posterior tibial artery was palpated, and the cuff was applied at about 2 cm above the ankle (medial malleoli) and inflated to at least 30 mmHg above when the Doppler could not detect any sounds. Cuff deflation was then proceeded slowly, no greater than 2 mmHg per second and the ankle systolic blood pressure was taken at the point at which the first Doppler signal appeared during deflation of the cuff. This was done two times and the mean calculated. The same procedure was then used to measure the systolic blood pressure at the dorsalis pedis artery and the higher value is the numerator of the ABI in each limb

The ankle–brachial index for each lower limb was calculated by dividing the higher of two mean systolic blood pressure readings at the ankle (i.e., one from the dorsalis pedis or from the posterior tibial artery) by the higher of the two mean brachial systolic blood pressure readings. For all clients, measurements on both lower limbs were obtained, and the lower value was considered as the patient's ABI. ABI ≤ 0.9 was considered diagnostic of PAD.

Ethical Considerations
All patients gave written informed consent to participate in the study and the study was approved by the community medicine department, College of Allied and Health Sciences, University of Cape Coast, Ghana as dissertation in partial fulfillment of the MB ChB program in 2015. Approval was also given by management of the hospital to conduct the study at the hospital.

Study definitions
PAD was defined as an ABI≤0.9. The diagnostic criteria for PAD based on the ABI were interpreted as follows[1]:

- Normal if 0.91–1.30
- Mild obstruction if 0.70–0.90
- Moderate obstruction if 0.40–0.69
- Severe obstruction if <0.40
- Poorly compressible if >1.30

Hypertension was defined as a blood pressure of ≥140/90 mmHg with diagnosis of diabetes or chronic kidney disesse OR ≥ 150/90 if age <60 years with no diabetes or chronic kidney disease OR ≥160/90 if age > 60 years with no diabetes or chronic kidney disease[18] OR being on hypertensive medications. We defined diabetes as a fasting glucose level ≥ 7.0 mmol/L[19] on two consecutive times, or taking medication for diabetes.

Statistical Analysis
Data were analyzed by using SPSS software version 19 (SPSS Inc, Chicago). Chi-squared test was used to assess the association between ABI and the following selected factors: age, gender, history of hypertension, and duration of diabetes. A p-value of less than 0.05 was considered statistically significant. The results for the descriptive statistics were presented using frequency tables.

3. Results

Demographics of Study Clients
A total of 200 adult diabetic clients with female predominance (71.5% females; 28.5% males) participated in the study (Table 1). Majority of the clients were within the 50-59 and 60-69 age groups. The highest educational level attained by the clients were Junior high school (38.0%), followed by no education (24.5%). The predominant ethnic group was Fante (65.3%), followed by Twi (23.1%).

Clinical history of Study Clients

Majority (34.5%) of the clients reported duration of their diabetes diagnosis between 5-10 years. Majority (88.5%) of the clients were also diagnosed with hypertension (Table 2). Majority (98.0%) also reported no smoking history.

Prevalence of PAD

The prevalence of PAD among the study clients on the right and left lower limbs were 17.5% and 18.0% respectively (Table 3). Majority had mild-moderate obstruction, with no severe obstruction obtained (Table 4).

Association between PAD and Clinical factors

Table 5 presents the association between PAD and selected clinical factors such as age, gender, hypertension and duration of diabetes. PAD was common among the 60-69 age group in both lower limbs. Prevalence was also high among the female clients, but with no statistically significance between PAD and sex. Prevalence of PAD was higher with increasing duration of diabetes with a significant association between PAD and duration of diabetes (p=0.035 in right lower limb and 0.037 in left lower limb) respectively. There was also a high prevalence of PAD among study clients with hypertension (91.4% in right leg and 94.4% in left leg) respectively.

Table 1: Socio-demographic characteristics of study client's.

Variable	Frequency (%)
Age (years):	
40-49	45 (22.5)
50-59	71 (35.5)
60-69	59 (29.5)
70-79	25 (12.5)
Sex:	
Male	57 (28.5)
Female	143 (71.5)
Religion:	
Christian	182 (91.9)
Muslim	15 (7.6)
Traditional	1 (0.5)
Marital Status:	
Single	1 (0.5)
Married	142 (71.0)
Divorced	23 (11.5)
Widowed	34 (17.0)
Educational level:	
No education	49 (24.5)
Primary	24 (12.0)
JHS/Middle	76 (38.0)
SHS/Vocational	25 (12.5)
Tertiary/Polytechnic	23 (11.5)
Post-graduate	3 (1.5)
Ethnicity:	
Twi	46 (23.1)
Fante	130 (65.3)
Ewe	10 (5.0)
Ga Adangme	3 (1.5)
Hausa	10 (5.0)
Occupation:	
Civil servant	9 (4.5)
Public servant	33 (16.5)
Retired	61 (30.5)
Student	1 (0.5)
*Other	96 (48.0)

*Other includes: farmers; fishermen; fishmongers and petty traders

JHS: Junior high school; SHS: Senior high school

Table 2: Clinical history of Study Participants

Variables	Frequency (%)
Duration of Diabetes (yrs):	
<1	19 (9.5)
1-4	67 (33.5)
5-10	69 (34.5)
11-15	25 (12.5)
>15	20 (10.0)
History of Smoking:	
Yes	4 (2.0)
No	196 (98.0)
Hypertension diagnosis:	
Yes	177 (88.5)
No	23(11.5)

Table 3: Prevalence of PAD in right and left lower legs

Variable	Right lower leg n (%)	Left lower leg n (%)
Normal	165 (82.5)	164 (82.0)
PAD (AB1 <0.9)	35 (17.5)	36 (18.0)
Total	200 (100.0)	200(100.0)

Table 4: Severity of PAD in both legs

Severity	Right lower leg n (%)	Left lower leg n (%)
Mild (ABI 0.70-0.90)	22 (62.9)	24 (66.7)
Moderate (ABI 0.40-0.69)	13 (37.1)	12 (33.3)
Severe (ABI <0.40)	0 (0.0)	0 (0.0)

Table 5: Association between PAD and selected clinical factors

Variables	PAD(Right leg) n (%)	PAD (Left leg) n (%)
Age (yrs):		
40-49	9 (25.7)	7 (19.4)
50-59	6 (17.1)	7 (19.4)
60-69	11(31.4)	14 (38.9)
70-79	9 (25.7)	8 (22.2)
p-value	**0.285**	**0.147**
Sex:		
Male	14 (40.0)	13 (36.1)
Female	21 (60.0)	23 (63.9)
p-value	**0.068**	**0.300**
Hypertension:		
Yes	32 (91.4)	34 (94.4)
No	3 (8.6)	2 (5.6)
p-value	**0.544**	**0.281**
Duration of Diabetes (yrs):		
<1	4 (11.4)	3 (8.3)
1-4	4 (11.4)	4 (11.1)
5-10	7 (20.0)	7(19.4)
11-15	10 (28.6)	12 (33.3)
>15	10 (28.6)	10 (27.8)
p-value	**0.035**	**0.037**

4. Discussion

Diabetes mellitus is a rapidly growing public health problem in Ghana and there is a strong association of PAD with diabetes. The objectives of the study were to 1) to estimate the prevalence of PAD in the right and left lower limbs among adult type 2 diabetic clients and 2) to assess any associations between PAD and selected clinical factors like sex, gender, hypertension and duration of diabetes.

In this study, we enrolled 200 adult type diabetic clients with 146 (71.5%) female predominance. Thirty-five clients (17.5%) had PAD (ABI < 0.90 on the right leg and 36 (18.0%) on the left leg respectively. Of these, 22/35 (62.9%) had mild PAD on the right leg and 24/36 (66.7%) on the left leg whiles 13/35 (37.1%) had moderate PAD on the right leg and 12/36 (33.3%) on the left leg respectively. Amongst those with PAD, no one had severe disease. The findings of majority of our study clients having mild PAD is similar to a study in Uganda by Okello et al[20] which showed a PAD prevalence of 24%, of which majority (87.27%) had mild PAD. This high prevalence of mild PAD in our study could be due to the very low rate of smoking (2.0%) and shorter duration of diabetes <10 years among the study clients. The prevalence of PAD in our study is within the range of several studies done in Sub-Saharan Africa that used a similar screening technique[5]. Prevalence of PAD was higher in females than males in our study because most of the diabetic clients were females as shown in the demographic data, but no statistically significant association was found between PAD and sex in our study. But other studies have reported an association of PAD with female sex [21].

PAD progresses more rapidly in diabetics and its prevalence also increases with age and the duration of diabetes[22]. This was evident in our study with a statistically significance ($p<0.05$) between PAD with duration of diabetes, however there was no statistically significant association between PAD and age in our study. A study in Nigeria by Oyedale et al also showed that PAD was associated with age, sex and marital status[6].

Studies have also reported an association of PAD with hypertension[23] and in our study, although the prevalence of PAD was higher among clients with hypertension, there was no significant association between PAD and hypertension. In another multi-racial cross sectional study performed in Malaysia, Asia to determine the prevalence of ABI in 200 diabetic patients at a primary care setting, the overall prevalence of PAD was 16% in this diabetic population. The prevalence of PAD was 5.8% in Malaysia, 19.4% in Chinese and 19.8% in Indians. However, no significant relationships were found between age, gender, smoking status, duration of diabetes mellitus, hypertension, dyslipidemia, and PAD[24].

5. Conclusions

This study documents a high prevalence of PAD among adult Ghanaian patientswith diabetes and early screening using ABI and treatment by medical professionals needs to be emphasized to help lower subsequent morbidity and mortality and systemic atherosclerotic diseases.

6. Conflict of Interest

None declared.

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(Writing Committee to Develop Guidelines for the Management of Patients with Peripheral Arterial Disease) Endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. J Am Coll Cardiol2006; 47(6): 1239-312.

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Author Profile

IA was the principal author and contributed to the study concept, design and interpretation and discussion of data. EKA contributed to the data collection and analysis of the data**.**