

Original Research Article

Assessment of peripheral arterial disease in diabetic adults with foot ulcers in an African population

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ABSTRACT

Background: Peripheral arterial disease (PAD) is a recognized risk factor for diabetic foot ulceration. It was thought that PAD is not common in Sub-Saharan Africa. Studies show otherwise. It becomes necessary to assess the prevalence of PAD among diabetic adults with foot ulcers in Nigeria. The objective of the study was to assess the prevalence of PAD in diabetic subjects with foot ulcers in Nigeria.

Methods: Diagnosis of PAD was made with the ankle-brachial index (ABI). Edinburgh claudication questionnaire was administered to the patients. An ABI of <0.9 is diagnostic of PAD. Risk factors for PAD were assessed. A control group of non-diabetic adults was used.

Results: Sixty-seven per cent (67%) of the test group has PAD as compared to 18% of the control group. Smoking, duration of diabetes and systemic hypertension were strongly associated with PAD.

Conclusions: Diabetic adults with foot ulcers in Nigeria have a high prevalence of PAD.

Keywords: Diabetics, Foot ulcers, Peripheral arterial disease, Nigeria

INTRODUCTION

Peripheral arterial disease (PAD) is one of the known risk factors for diabetic foot ulceration, the others being peripheral neuropathy and infection. Diabetic foot ulcers and gangrene are the leading cause of amputations in Nigeria.¹ The cost of treating a diabetic foot ulcer places a huge financial strain on the patient, most of whom have to pay from their pocket owing to lack of insurance coverage. Amputation results in a profound sense of loss of mobility and independence.² Coupled with poverty, unemployment and poor prosthetic services in developing country, prevention of foot ulcers and amputation cannot be overemphasized.

However, the assessment of a diabetic patient with foot ulcers is often hurried and not detailed in our environment. Rarely do physicians measure the ABI and check for peripheral neuropathy in most diabetics. This may be due to the busy clinic schedule or the feeling that PAD is not common in diabetics in Africa.³ However numerous studies have challenged this notion.^{3,4} The ABI is a simple and cost-effective method to detect early PAD.⁵ It is the ratio of the systolic blood pressure at the ankle to that of the arm. An ABI of less than 0.9 has been accepted as diagnostic for PAD.⁶

Apart from the prevalence of PAD, the risk factors for PAD has not been fully characterized in the African population. Hypertension, age, hyperlipidaemia, smoking

and sex have been variously cited as risk factors for PAD.⁷ However, a local study has found that hyperlipidaemia is not a risk factor for PAD among Nigerians.⁸ It will be interesting to further investigate the risk factors for PAD among diabetic patients in Nigeria.

We decided to assess the burden of PAD among diabetic adults presenting to the Orthopaedic and Plastic surgery units of our hospital. We hope that the results of this study will sensitize our physicians to be more detailed in their assessment of a diabetic patient. This is important as early detection can lead to preventive measures such as vascular bypass or interventional radiological treatment before critical limb ischaemia occurs.

METHODS

This was a cross-sectional study done at National orthopaedic hospital Enugu (NOHE), a Government-owned regional hospital in South-East Nigeria. Its catchment area includes the 9 states in the South-South and South-East geopolitical zones of the country. It is a tertiary referral centre for Orthopaedics and Plastic surgery.

The study was conducted from August 1st, 2016 to July 2017. A total of 160 subjects were recruited from the Orthopaedic and Plastic surgery clinics and from the wards. Sixty were diabetic adults with unilateral foot ulcers, while 60 were a similarly matched control group of non-diabetic adults with no foot pathology. All diabetic subjects with unilateral foot ulcers (Wagner grade 1, 2 and 3) who presented to the hospital within this period and gave consent were included.

Exclusion criteria were subjects with bilateral feet ulcers, gangrene of the foot (Wagner grade 4 and 5), medically unstable patients, previously diagnosed PAD, and a refusal of consent. The ABI was measured with Sonotrax 8 MHz continuous wave vascular Doppler (made by EDAN Instruments Inc., China). The fasting blood glucose was measured with Kernel Multicheck electronic meter (Brand hospital and Homecare, Taiwan).

The ABI is the ratio of the systolic blood pressure in each leg to the higher of the left or right arm systolic pressure. The higher of the ankle systolic pressure of each leg (dorsalis pedis or posterior tibial) is taken as the ankle pressure of that leg. The ABI was obtained for both the affected and normal legs in the diabetic subjects. The mean value was calculated for both the legs with ulcers and legs without ulcers for the diabetic group separately. The ABI of the control group was taken as the mean ABI of both legs. This value of the control group was then compared to the mean ABI of the legs with ulcers and legs without ulcers respectively in the diabetic group.

The Edinburgh claudication questionnaire (ECQ) was also administered to the participants. This questionnaire is designed to detect symptoms of intermittent

claudication in those with PAD of the lower extremity. Relevant biodata and questions regarding risk factors for PAD such as age, sex, duration of diabetes, smoking and hypertension were collected with a separate questionnaire.

Data were analyzed with IBM SPSS software version 20. Continuous data were represented as means and standard deviations, while categorical data were presented as frequencies. Student t-test was used to compare the difference in the mean values of the ABI in the study groups. Pearson's correlation was used to assess the relationship between continuous variables while chi-square test was used for the relationship between categorical variables. A p-value less than 0.05 is considered statistically significant.

RESULTS

There were 32 males (53.30%) and 28 females (46.70%) in the control group, while the proportion was equal in the test group, 30 each (50%), as shown in figure 1. One hundred and sixteen (96.7%) were Nigerians, 1(0.8%) Cameroonian, 1 (0.8%) Togolese and 2 (1.7%) from Benin Republic. The mean age of the participant was 53.72+12.38 years and 51.17+12.01 years respectively in the test and control group (p=0.24). The median duration of diabetes was 9 years with minimum and maximum durations being 2 and 20 years respectively. The mean fasting blood glucose was 80.00+12.30 mg/dl and 137+26.50 mg/dl in the control and test groups respectively.

Table 1. The distribution of PAD and Intermittent claudication in the study groups. (n= 120)

	Diabetic subjects (%)	Non-diabetic subjects (%)
Have PAD	62	18
Have IC	22	55

The mean ABI in the control group (non-diabetic adults) was 1.03+0.15. The mean ABI in the affected leg of the diabetic subjects was 0.79+0.18, while it was 0.83+0.15 in the non-affected leg. Both of these values were significantly lower than the value in the non-diabetic subjects (p=0.000). Thirty-seven diabetic subjects (61.70%) have PAD, compared to 11(18.30%) of the control group (p=0.000). However, only 8 diabetic subjects (21.60%) reported symptoms of claudication compared to 6 non-diabetic adults (54.50%) when assessed with the Edinburgh claudication questionnaire (p=0.019). This is illustrated in Table 1.

Multivariate analysis showed that systemic hypertension, smoking, and duration of diabetes are significantly associated with PAD, while age and sex are not associated, see Table 2.

Table 2. The relationship between PAD and predictor variables.

Predictor variables	Test statistics*/ p value	Interpretation
Age	$r=-0.20$, $p=0.08$	Weak negative correlation with ABI, not significant
Sex	$\chi^2=3.76$, $p=0.053$	Not significant
Hypertension	$\chi^2=26.29$, $p=0.000^*$	Significant
Smoking	$\chi^2=18.39$, $p=0.000^*$	Significant
Duration of diabetes	$\rho = -0.375$, $p=0.003^*$	Moderate negative correlation with ABI, significant

* r =Pearson's correlation coefficient, χ^2 =chi-square test statistic, ρ = spearman's correlation coefficient.

Table 2 illustrates the relationship between PAD and some predictor variables. It shows that PAD is significantly associated with hypertension, smoking and duration of diabetes.

DISCUSSION

This study has shown that PAD is very common in diabetic subjects in Africa. Recent studies have a similarly high incidence of PAD among diabetic subjects in other sub-Saharan African countries.⁸⁻¹⁰ The prevalence of PAD in this study is higher than that reported in western studies.^{11,12} The lower incidence in the west may be due to early detection and aggressive intervention which prevents propagation of the disease. It may also an actual overall higher prevalence of PAD among Africans.

The finding of a lower mean ABI in the contralateral apparently normal leg in the diabetic subjects suggests that this limb is already at risk of developing ulceration. This is not surprising since PAD is more severe and diffuse in the diabetic patient.¹³ Angiographic studies have shown that PAD involves mainly the infra-popliteal region in diabetic subjects.¹³ Hence it becomes imperative that these patients must be thoroughly assessed to prevent the development of foot disease.

Diabetic patients are less likely to feel the pain of intermittent claudication as assessed by the ECQ. This makes reliance on clinical symptoms to detect PAD unreliable. This may be due to the presence of concomitant peripheral neuropathy which may blunt the sensation to painful stimulus.⁸ This causes a delay in the presentation of patients to the hospitals before the onset of foot ulceration. Other studies found a similar pattern among diabetic subjects. Ikem et al noted the lower sensitivity of clinical methods when compared to Doppler in diagnosing PAD in diabetic patients.⁸ Rabia and Khoo

found that the sensitivity of the ECQ was 25% in diabetic subjects, and concluded that ECQ is not a good screening tool for PAD in diabetic subjects.⁶

The risk factors for PAD in this study include systemic hypertension, smoking and duration of diabetes. This is in agreement with findings from other studies.^{7,14} Hypertension causes arteriosclerosis and can accelerate the buildup of atheromatous plaques with resultant luminal narrowing. Hypertension was also commoner in diabetic subjects compared to non-diabetic subjects in this study.

Duration of diabetes moderately correlated with PAD among diabetic patients in this study. Other local studies have confirmed this observation.^{7,8} Since diabetes mellitus is an independent risk factor for PAD, it is expected that the longer the duration the higher the likelihood of developing PAD. It is possible that tight glycaemic control can ameliorate this risk.

However, age and sex were not found to be significantly associated with PAD. While most studies failed to show an effect of sex on PAD, the reports on age are conflicting.¹⁴⁻¹⁷ It is possible that barring the effects of other risk factors such as hypertension and diabetes, both of which are common with advancing age, age alone might not significantly reduce the ankle-brachial index.

CONCLUSION

Peripheral arterial disease is quite common in diabetic subjects in Nigeria, unlike the previous assumption. Relying only on clinical symptoms to diagnose PAD is misleading and should be discouraged because many diabetic subjects will not have pain due to concomitant peripheral neuropathy.

Recommendations

Assessment of diabetic patients should be thorough and must include a vascular examination of both legs. The ankle-brachial index is a simple cost-effective method of screening for PAD and should be used in the initial vascular assessment. Concomitant risk factors for PAD in diabetic patients such as systemic hypertension and cigarette smoking should be sought and aggressively controlled.

Limitations

A multicenter multinational study will increase both the sample size and patient diversity which would give a truer picture of PAD prevalence in the African continent.

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