RESEARCH ARTICLE

Arterial involvement of lower limbs in peripheral artery disease - the difference between diabetics and non-diabetics

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Abstract

Objective: To detect peripheral artery disease in diabetic and non-diabetic individuals.

Method: The case-control study was conducted from October 2018 to September 2019 at Ruth K.M. Pfau Civil Hospital, Karachi, and comprised diagnosed diabetic patients with random blood sugar ≥200mg/dl in group A, and healthy non-diabetic subjects in group B. Ankle brachial pressure index was measured and mean luminal diameters of lower limb arteries were compared using colour Doppler ultrasonography. Data was analysed using SPSS 21.

Results: Of the 82 subjects, 41(50%) were in each of the 2 groups. The sample had 42(51.2%) males and 30(48.8%) females with overall mean age of 53.9±5.07 years (range 44-60 years). There was significant difference in the ankle brachial pressure index values between the groups (p=0.004). There was also a significant difference in the mean luminal diameters of distal arteries (p=0.001), while there was no significant difference in proximal arteries (p>0.05).

Conclusion: The diabetics were more prone to developing peripheral arterial disease than nondiabetics.

Key Words: Blood Glucose, Ankle, Arteries, Ultrasonography, Angiopathies

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Introduction

Lower limbs are essential parts of the locomotor system for the provision of movement and locomotion. The blood supply to lower limb arises from the iliofemoral system[1]. Peripheral arterial disease (PAD) is the narrowing of peripheral arteries due to decreased blood flow resulting from atherosclerosis (Figure 1). According to the American Heart Association, PAD is usually caused by the formation of plaque below the level of bifurcation of the abdominal aorta that affects more than 12 million Americans[2]. Patients with PAD mostly remain undiagnosed, asymptomatic and untreated, but the condition gradually leads towards ischaemia of lower limb arteries. Eventually, the ischaemia results in intermittent claudication, ulcers, gangrene and amputation of the limbs[3].

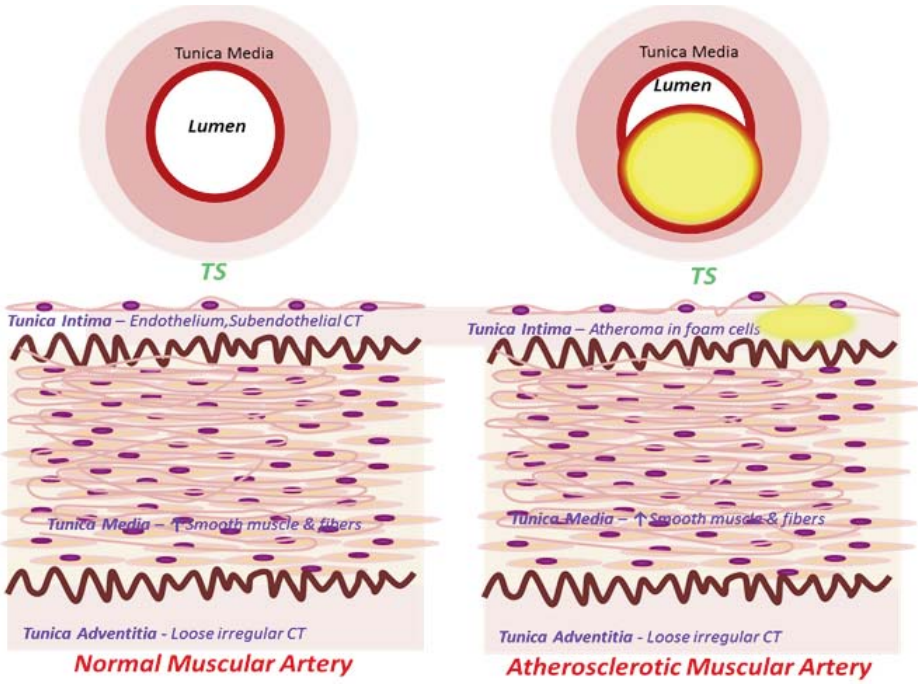

Figure-1: Cross-sectional view of the arterial wall showing histology of the normal artery and atherosclerotic artery which has accumulation of the plaque and invasion of foam cells.

Diabetes mellitus (DM) is the leading cause of PAD mostly in lower limb arteries[4]. About 463 million individuals were diabetic worldwide in 2020, and the International Diabetes Federation (IDF) has predicted that this number could increase up to 700 million by 2045[5]. In 2019, around

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19 million adults were diagnosed in Pakistan as having DM and its related complications[6].

The prevalence of PAD worldwide in the general population is 3-7% in both males and females aged <50 years, while it increases to 7-12% in individuals aged >60 years, and about 20% in those aged >80 years[7]. PAD is the 3rd notable cause of atherosclerosis after coronary artery disease (CAD) and stroke. PAD is an early indicator of coronary and cerebral atherosclerosis. Data suggested that individuals having PAD had 3-5 times higher risk of developing CAD compared to those who did not have PAD[8].

The current study was planned to detect PAD in diabetic and non-diabetic individuals to facilitate early detection in high-risk individuals.

Materials and Methods

The case-control study was conducted from October 2018 to September 2019 at the Department of Surgery, Ruth K.M. Pfau Civil Hospital, Karachi. After approval from the Institutional ethics review board,

The sample size was calculated using OpenEpi[9] with 95% 2-sided confidence interval (CI), 80% power of the study, and mean values of lumen diameter of dorsalis pedis artery for non-diabetics and diabetics in the light of literature[10]. The sample was raised using simple convenience non-probability sampling technique. Those included were diagnosed DM patients in group A, and healthy non-diabetic subjects in group B.

Type 2 DM (T2DM) patients were selected using the American Diabetic Association (ADA) criteria[11] with uncomplicated disease status having either random blood glucose (RBG) >200mg/dL (≥11.1mmol/L) or fasting blood glucose (FBG) >126mg/dL (≥7mmol/L), who were aged 40-60 years, had a T2DM history of >5 years, and were already taking oral hypoglycaemic agents (OHAs) or/and insulin.

Non-diabetic group comprised of individuals who came to the department for any procedure, including hernia, appendicectomy, cholecystectomy, etc., with RBG <200mg/dL (≤11.1mmol/L) or FBG <100mg/dL (≤5.6mmol/L).

The exclusion criteria comprised the following elements: patients with a history of trauma, surgery, leg ulcers, gangrene or amputation of lower limb (complicated T2DM)), type 1 DM (T1DM) patients, pre-diabetic patients (FBG 100-125mg/dL, glycated haemoglobin [HbA1c}: 5.7-6.4%), patients already diagnosed with arthritis, those with malignancy, patients with pre-existing known vascular disease, deep vein thrombosis (DVT), filariasis or lower limb swelling due to other causes, patients already diagnosed with coronary and cerebrovascular artery disease, patients with >1.3 ankle-brachial pressure index ABPI), wheelchair-bound or bed-bound patients, those who were going for arterial graft procedures, smokers and hypertensive patients.

Informed consent was obtained from all the participants. Each participant was assessed through detailed history that was collected using a predesigned questionnaire in simple language. Data was also collected through physical and clinical examination using a predesigned proforma. Lower limbs were examined to determine any hair loss, oedema, redness, discolouration or absent pulse. The procedure of ABPI was based on the criteria outlined by the American College of Cardiology / American Heart Association (ACC/AHA) [12]. ABPI was assessed after taking 5-minute rest in supine position with a 8MHz Doppler device. The procedure started after measuring the systolic blood pressure (SBP) of brachial artery in both arms. After that, SBP of dorsalis pedis artery was measured in both ankles proximal to the malleoli. The highest SBP values of both arteries were noted.

The Doppler is a non-invasive and safe technique for the assessment of lower limb arteries calibre. The procedure started with linear transducer of high frequency probe (9-12MHz), examining the arterial segments. The parameters assessed by colour Doppler ultrasonography included lumen diameter of lower limb arteries, colour flow pattern, plaque distribution, frequency of plaques in different arterial territory, and the degree of stenosis.

Data was transferred to MS Excel, and was analysed using SPSS 21. Statistical differences between the two groups were calculated using the t-test for continuous and chi-square for categorical variables with a significance level of 95%. To check data normality, Shapiro-Wilk test was used. Correlation analysis was applied to evaluate the strength or association between HbA1c and luminal diameters. P≤0.05 was considered statistically significant.

Results

Of the 82 subjects, 41(50%) were in each of the 2 groups. The sample had 42(51.2%) males and 30(48.8%) females with overall mean age 53.9±5.07 years (range 44-60 years). In group A, 37(90.24%) patients had a T2DM history of 5-10 years, and 4(9.75%) had a history of 11-15 years.

A total of 78(95.1%) subjects had normal ABPI value >0.9, while 4(4.9%) had 0.5-0.9 and, as such, were diagnosed as having PAD.

Table-1: ABPI ratio in diabetic and non-diabetic groups.

ABPI ratio	Diabetic Status		Total	p-value
Biochemical	Diabetics	Non-diabetics		
Normal (>0.9)	37	41	78	
PAD (0.5-0.9)	04	0	04	0.040*
Total	41	41	82	

*p<0.05 = significant.

ABPI: Ankle-brachial pressure index, PAD: Peripheral artery disease.

There were 37(90.24%) diabetics and 41(100%) non-diabetics with normal ABPI (p=0.04) (Table 1).

Mean luminal artery diameters of lower limb arteries were significantly different (p=0.001) below the knee, but not above the knee (Table 2).

Table-2: Intergroup comparison of lumen diameter of lower limb arteries.

Arterial Lumen Diameter	Diabetic Status		p-value
	Diabetics Mean ± S.D. (cm)	Non-diabetics (n=41) Mean ± S.D. (cm)	
CFA	0.82 ± 0.07	0.83 ± 0.06	0.64
SFA	0.73 ± 0.05	0.74 ± 0.05	0.61
PopA	0.52 ± 0.08	0.54 ± 0.06	0.29
ATA	0.18 ± 0.06	0.27 ± 0.03	0.001
PTA	0.17 ± 0.04	0.19 ± 0.01	0.001
DPA	0.12 ± 0.02	0.25 ± 0.03	0.001

*p<0.05 = significant.

CFA: Common femoral artery, SFA: Superficial femoral artery, PopAA: Popliteal artery, ATA: Anterior tibial artery, PTA: Posterior tibial artery, DPA: Dorsalis pedis artery

Overall, triphasic spectrum was noted in 79(96.34%) subjects; 38(92.68%) in group A and 41(100%) in group B. The biphasic pattern was observed in 3(3.65%) individuals, and all of them were in group A. (Figure 2).

Discussion

Pakistan currently ranks sixth in terms of the total number of existing DM patients, and if no preventive measures are taken, it is expected to jump to number four by 2030[13]. In the current study, significant difference was found in distal (below-the-knee) arteries (p<0.05), while there was no significant difference (p>0.05) in diabetics and nondiabetics with respect to luminal diameters of proximal (above-the-knee) arteries. The most probable reason is that PAD initially commonly affects below-the-knee arteries before gradually affecting the above-the-knee arteries[14].

The current study found narrowing of the luminal diameter in bilateral DPA, unilateral anterior and posterior tibial arteries. This is inconsistent with the findings of Shaheen et al[15].

Gray et al. suggested that selective screening should target those who have DM, older age, increased uric acid, obesity, and cholesterol levels[16].

In the current study, 51.2% were males and 48.8% were females. Out of 4 PAD patients, 3(75%) were males and 1(25%) was female. The findings showed a male-to-female ratio of 3:1, indicating that males are more prone to having PAD than females. The study by Meyer and Barton suggests that oestrogen has a protective role in preventing PAD[17].

In the current study, most of the individuals 37 diabetics had a history of 5-10 years, while 4 had diabetes for 11-15 years. This may be explained by the fact that PAD remains asymptomatic initially, and becomes symptomatic mostly after 10 years[18].

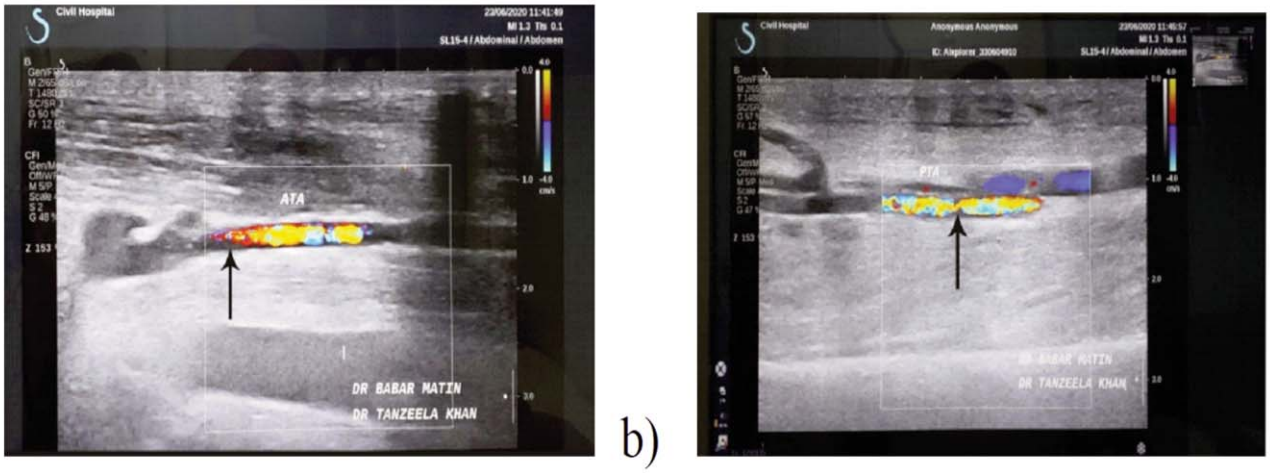

Figure-2: Colour Doppler image showing reduced blood flow in (a) anterior tibial artery (ATA) and (b) posterior tibial artery (PTA) (indicated by arrows).

The current study has limitations as DM duration could not be verified from medical records. Besides, it was a single-centre study with a small sample size.

Despite the limitations, however, the current study is significant. The main presentation of PAD patients in Pakistan is at the stage of ulcer formation and gangrene. For such patients, amputation is the only modality of treatment. Very few patients are diagnosed at an early asymptomatic stage when the preventive and other treatment measures can be taken to avoid amputation. The current study would be beneficial as it will encourage physicians to keep an eye on the condition while dealing with DM patients.

Multicentre studies with larger sample sizes are recommended.

Conclusion

Diabetics were more prone to developing PAD than nondiabetics. The most commonly affected was the dorsalis pedis artery.

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Conflict of Interest: None.

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