Ankle Brachial Index as Diagnostic Marker for Asymptomatic Peripheral Arterial Disease in Diabetes Mellitus

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ABSTRACT

Objective: To determine ankle brachial index (ABI) as a diagnostic marker for asymptomatic peripheral arterial disease (PAD) in diabetes mellitus (DM).

Study Design: Cross-sectional study.

Place and Duration of Study: Combined Military Hospital, Hyderabad, Pakistan from Jan to Sep 2022.

Methodology: A total of one hundred and seventy (n=170) asymptomatic patients with DM were included. Specific details were recorded, which include HbA1c levels, duration of diabetes and ankle brachial index.

Results: There were 60.0% male and 40.0% female patients. With the mean age of 50.60±11.55 years. The mean duration of diabetes mellitus was 4.20±1.97 years. Mean HbA1c was 7.41±1.27%, mean ABI was 1.03±0.13. Peripheral arterial disease was observed in 17.05% of asymptomatic cases using ABI, with ABI sensitivity of 82.86% and specificity of 97.24% in detecting asymptomatic PAD patients. It was significantly associated with an increase in the duration of diabetes.

Conclusion: Asymptomatic peripheral arterial disease diagnosed through the ankle brachial index showed that it is a reliable source for diagnosing patients with asymptomatic PAD in diabetes mellitus reported in routine clinical visits.

Keywords: Asymptomatic peripheral arterial disease, Ankle brachial index, Intermittent claudication, Glycated hemoglobin, Diabetes complications.

INTRODUCTION

Peripheral arterial disease (PAD) is a macrovascular complication of diabetes mellitus (DM). It often gets detected at an advanced stage with a full flare of symptoms, leading to an increase in mortality and morbidity, having a detrimental impact on the quality of life.[1] Worldwide, the Prevalence of PAD is approximately 236.62 million, and the prevalence of DM is 2000 million.[2] However, the presence of DM increases the rate of developing PAD and its prevalence in diabetic patients diagnosed by measuring ABI is 23.5% in Europe and 17.7% in Asia, emphasizing the importance of the correlation between PAD and DM.[3,4]

Diagnosis of peripheral arterial disease in DM is difficult to assess as it remains asymptomatic because of a decreased perception of pain secondary to peripheral neuropathy or minor symptoms for which patients do not report, and it remains undetected,

leading to complications.[5] The American Heart Association (AHA) recommended PAD screening through ABI in all patients aged 50 or more, particularly those who smoke and those with DM.[6] The American Diabetes Association also recommends ABI screening DM patients older than 50.[7]

It has been observed that asymptomatic PAD in DM remains undiagnosed until the burden of the disease makes patients symptomatic and report to the clinic for treatment.[8] In addition, ABI is not routinely done in asymptomatic patients reporting at diabetic clinics, and undiagnosed PAD patients may go unnoticed. To overcome this problem, a simple and non-invasive diagnostic procedure of acquiring ABI in all DM patients independent of age and PAD symptoms must be carried out in routine clinic visits.[9]

Ankle Brachial Index (ABI) is a reliable diagnostic test for symptomatic PAD patients.[10] However, no study was found on patients from Pakistan regarding the reliability of ABI as a diagnostic marker for asymptomatic PAD patients with DM. The rationale of our study is to determine the frequency of

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asymptomatic PAD in diabetic patients using ABI as a diagnostic marker to emphasize the importance of performing ABI in routine clinic visits as an early diagnostic tool for asymptomatic PAD to reduce the risk of future irreversible complications.

METHODOLOGY

The cross-sectional study was conducted at the Department of Medicine, Combined Military Hospital, Hyderabad Pakistan, from January to September 2022, after the approval of the Ethical Review Committee (11108/, estb; Dated 06 Jan 2022). The sample size was calculated by using the WHO sample size calculator taking the prevalence of peripheral arterial disease (PAD) in patients of diabetes at 3.2%.[11]

Inclusion Criteria: Asymptomatic patients of diabetes mellitus, of either gender, aged 30-70 years without target organ damage with a duration of diabetes not exceeding ten years and not using insulin, were included.

Exclusion Criteria: Patients with symptoms of PAD, including numbness of feet, intermittent claudication of lower limb, diabetic patients using insulin for treatment, and patients with lower limb ulcers, gangrene and amputation, were excluded.

Informed consent of the selected participants was taken. At the same time, specific details of every participant were recorded on a data collection proforma, which included the patient's HbA1c levels along with the duration of diabetes and the measured Ankle Brachial Index (ABI). Moreover, using a hand-held Doppler (LifeDop-L 150, vascular Probe 8 MHz, hand-held Summit Doppler), the highest systolic ankle blood pressure from the Posterior Tibial artery was taken, which was then divided by the highest systolic blood pressure of the arm using the brachial artery. A ratio or index was calculated and recorded following the blood pressure measurements.

Data analysis was performed using a Statistical Package for Social Science (SPSS) V 25.0. Mean±standard deviation was calculated for quantitative variables. Frequency and percentage were calculated for qualitative variables. ABI was calculated as the ratio of the highest systolic pressure at the ankle (ankle pressure) and the highest systolic pressure at the arm (brachial pressure) using a sphygmo-manometer and hand-held Doppler.[12] The normal ratio of ABI is 0.9-1.3, and a value of less than 0.9 is considered PAD. Sensitivity, specificity, and accuracy were calculated for ABI and compared with Doppler ultrasound for diagnoses of asymptomatic PAD.

RESULTS

A total of one hundred and seventy (n=170) Asymptomatic diabetic patients were included in this study. Out of the total, 102 (60.0%) patients were male, and 68(40.0%) were females with the mean age of 50.60±11.55 years. The mean duration of DM was 4.20±1.90years. The Mean of HbA1c was 7.41±1.27%, the mean value of systolic blood pressure in the ankle was 129.8±14.6 mmHg, and the mean value of systolic blood pressure in the arm was 125.3±17.0 mmHg (Table-I).

Table-I: Demographic Characteristics of Patients (n=170)

Parameters		Values
Gender	Male	102(60.0%)
	Female	68(40.0%)
Age in years	Mean±SD	50.60±11.55
	Range	30-70
Duration of Diabetes Mellitus in years	Mean±SD	4.20±1.90
	Range	1-10
HbA1c (%)	Mean±SD	7.41±1.27
	Range	5.1±11.6
Systolic Blood Pressure Ankle (mmHg)	Mean±SD	129.8±14.6
	Range	100±200
Systolic Blood Pressure arm (mmHg)	Mean±SD	125.3±17.0
	Range	100-200

The outcome of our study revealed that peripheral artery disease was observed in 29(17.05%) of asymptomatic patients of diabetes using ABI. Results were further verified with Doppler ultrasound (DUS) which revealed a sensitivity of 87.88%, specificity of 97.08%and accuracy of 95.29% in detecting asymptomatic PAD using ABI in DM patients as represented in Table-II.

Table-II: Diagnosis Parameters of Study Subjects (n=170)

Asymptomatic Patients Ankle Brachial Index	Doppler ultrasound (DUS)	
	Positive (n=33)	Negative (137)
Positive (n=33)	29	4
Negative (n=137)	4	133
Diagnosis Parameters	Values	
Sensitivity	87.88%	
Specificity	97.08%	
Positive Predictive Value (*)	87.88%	
Negative Predictive Value (*)	97.08%	
Accuracy (*)	95.29%	

DISCUSSION

This study was undertaken to determine ABI as a diagnostic marker for asymptomatic PAD in DM patients reporting in the outpatient department of the hospital setting. The burden of non-communicable disease (NCD) is growing globally at an exponential rate because of an increase in life expectancy, exposure to the risk factor, sedentary lifestyle and synthetic diet consumption.[12,13] Atherosclerotic PAD-associated cardiovascular ischemic event has high mortality with three-fold increases in risk, and in the USA alone, about 150,000 ischemic amputations of the limbs are done to save a life, which is more than the war-sustained amputations from 2001-2011.[14] Modifiable risk factors, including DM, high blood pressure, tobacco smoking, high blood cholesterol, high body mass index (BMI) and physical inactivity, can accelerate the development of PAD, elderly population experiences increased exposure to these risk factors and have high prevalence of PAD among them (1 in 10 people aged over 70 to 1 in 6 people aged over 80), there is no major sex predilection of the disease, earlier and sustained exposure to the risk factor increases the likelihood of acquiring the disease at an early age, Framingham heart study found PAD in 20% of symptomatic patients with DM.[15] Fontaine classification further subdivides PAD into four stages i.e asymptomatic stage I to stage IV with ischemic ulcer and gangrene.[16] The Prevalence of PAD among DM patients in Pakistan is 31.6%, and uncontrolled DM, which is 39% of the total DM population in a community-based study, causes early onset PAD.[17] However, early detection of PAD is difficult because peripheral neuropathy in DM masking the ischemic symptoms of pain and ankle systolic pressure may appear falsely elevated.[18] Asymptomatic PAD can be detected early using ABI, which can be performed in outpatient clinics on routine patient visits.[19] ABI is a simple, non-invasive, accurate and reliable diagnostic procedure with a high level of sensitivity and specificity compared to arteriography, which is the gold standard for diagnosing PAD.[20] ABI values of <0.9 in DM with asymptomatic PAD are associated with a high risk of coronary artery disease (CAD) and Cerebrovascular disorder (CVD).[20]

The observation in our study concluded that 17.05% of patients with DM were suffering from asymptomatic PAD, which is lower than detected in a previous study by Alagha et al. which reported 39.2% of PAD patients with DM.[21] This variation may also be due to the difference in the timing of the two studies and the inclusion of symptomatic PAD patients with DM in the previous study. However, our study exclusively included only asymptomatic patients of PAD with DM. The result of our study was in simulation with other comparable studies with a 17.05% frequency of asymptomatic PAD in DM by using ABI as the diagnostic procedure, where results were further verified by Doppler ultrasound. The calculation was done with a resultant sensitivity of 82.8%, specificity of 97.2% and accuracy of 94.4% in detecting asymptomatic PAD in DM using ABI. These findings were inconsistent with the results of other contemporary studies, which documented that the female gender was much more affected than males.

LIMITATIONS OF STUDY

The study has limitations, the sample cannot represent the entire population of the community. Doppler ultrasound was selectively applied in asymptomatic PAD patients diagnosed using ABI to verify their results. Despite these limitations, the current study has identified a very significant aspect of diabetic patients' health and provided the latest magnitude of the burden of asymptomatic PAD among patients with diabetes mellitus.

CONCLUSION

This study concluded that asymptomatic peripheral arterial disease is found in many diabetic patients using the simple, non-invasive ankle-brachial index method. A strong correlation was further observed between ABI and Doppler ultra.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SYA & MNQ: Conception, study design, drafting the manuscript, approval of the final version to be published.

MMAN & SAJ: Data analysis, data interpertaion, drafting the manuscript, approval of the final version to be published.

MWJ & HA: Data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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