

Utility of Ankle Brachial Index (ABI) as a Screening Tool for Peripheral Artery Disease in Type 2 Diabetes Mellitus Patients in a Tertiary Hospital

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Abstract

Background: Diabetic patients are at high risk for Peripheral Arterial Disease (PAD). Early diagnosis of PAD can help patients effectively manage the condition and prevent its long-term complications. The Ankle-Brachial Index (ABI) measurement is a simple, non-invasive, reproducible, and cost-effective tool for diagnosing PAD.

Objectives: To determine the proportion of PAD in patients with type 2 diabetes mellitus in a tertiary care hospital and to compare ABI with Colour Doppler Ultrasonography

Materials and Methods: This facility-based cross-sectional study was conducted using 207 records of diabetic patients who attended the Podiatry Clinic in the Department of Physical Medicine and Rehabilitation at PSGIMSR, Coimbatore. Data were collected using a semi-structured questionnaire, entered in MS Excel, and analyzed using SPSS software version 28.0. Appropriate descriptive and inferential statistics were employed, with a p-value of <0.05 considered significant.

Results: The mean age of the study participants was 58 years, with approximately 62% being male. About 54.6% had an abnormal ABI index. Among those with abnormal ABI, 71.6% of them had mild PAD, 21.2% moderate PAD, and 7% severe PAD. Among those with abnormal ABI, bilateral involvement was seen in about 38.9% of the participants, followed by right-side involvement in 35.3%, and left-side involvement in 25.6%. Among those 113 ABI positive patients, about 39 patients were subjected to a doppler study and the positive predictive value was found to be 51.3%.

Conclusion: The study demonstrates the high prevalence of peripheral artery disease (PAD) among participants, with mild PAD being most common and a significant portion having bilateral involvement. The ABI index showed moderate predictive accuracy for PAD when compared to Doppler studies. These findings underscore the need for routine screening and confirmatory testing to improve PAD diagnosis and management.

Keywords: Type 2 Diabetes Mellitus, Peripheral artery Disease, Ankle Brachial Index.

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Introduction

Diabetes mellitus is one of the leading non-communicable diseases, affecting both large and small blood vessels. One of the macrovascular complications of Type 2 Diabetes Mellitus (DM) is Peripheral Arterial Disease (PAD). [1]

The occurrence of PAD is more common among individuals with diabetes and primarily affects the lower extremities. In severe cases, PAD manifests as claudication or gangrene, but it often goes unnoticed in many cases. Approximately 40% of

individuals with PAD do not exhibit any symptoms, while an additional 50% experience various limb symptoms that differ from typical intermittent claudication. [1] The Ankle Brachial Index (ABI) measurement has emerged as a non-invasive and cost-effective method for detecting Peripheral Arterial Disease (PAD). A patient is diagnosed with PAD when the ABI is less than 0.9. [2,3] The ABI has been validated against colour doppler ultrasound, showing a sensitivity of 72.2% and a specificity of 85.71% in identifying PAD. [3]

Various studies have been conducted on this topic. The study by Mithilesh Yadav et al. [4] found that 42% of participants had an abnormal ABI. Similarly, other studies using the ABI index have reported results ranging from 25.8% to 76%. [1-6]

Diabetic patients are at high risk for Peripheral Arterial Disease (PAD). Early diagnosis of PAD is crucial for effective management and prevention of its long-term complications. Determining the proportion of diabetics with PAD is challenging due to its often-asymptomatic nature and the presence of neuropathy. The Ankle-Brachial Index (ABI) measurement is a simple, non-invasive, reproducible, and cost-effective tool for diagnosing PAD.

Objectives

1. To determine the proportion of PAD in patients with type 2 diabetes mellitus is a tertiary care hospital.
2. To compare ABI with Colour Doppler Ultrasonography

Materials and Methods

This facility-based cross-sectional study using retrospective data was conducted using the records of diabetic patients who attended the Podiatry Clinic in the Department of Physical Medicine and Rehabilitation at PSG Institute of Medical Sciences and Research, Coimbatore. The study was conducted during the period of February 2024 to July 2024.

Data from 207 type 2 diabetes mellitus patients who attended the podiatry clinic between August 2023 to January 2024 were included. From the case sheets, the required data were retrieved. The Ankle-Brachial Index (ABI) measurements were noted from the records of the patients. Doppler study was conducted on some patients who showed a positive ABI, and those details were also recorded from the records. The colour Doppler ultrasound was done and interpretation was done by trained clinician. The details of the Doppler study were available for 39 patients only. The patients with long term

diabetes, symptomatic diabetic patients, and patients with diabetes related deformity in leg, patients with any ulcer over legs or discolouration over legs were selected for colour doppler ultrasound. Institutional Human Ethics Committee Approval was obtained (Ref no.: PSG/IHEC/2024/Appr/Exp/048 – 23/548). Data were entered in MS Excel and analysed using SPSS version 28. Descriptive statistics like mean, standard deviation, frequency, and proportion was used. Positive predictive value was calculated.

Operational Definition: Ankle Brachial Index - ABI is calculated by dividing the systolic blood pressure measured in the arterial conduits at the level of the ankle by the systolic blood pressure measured in the brachial artery. According to American College of Cardiology and American Heart Association, ABI ratios are interpreted as follows: >1.30 : Non-compressible vessels, 1.00 to 1.29: Normal, 0.91 to 0.99: Borderline (equivocal), 0.41 to 0.90: Mild to moderate PVD, 0.00 to 0.40: Severe PVD.

Results

The details in the 207 diabetic patient's records were taken and analyzed. The results are depicted below. The mean (SD) age of the study participants is 58 years (15 years). About 61.8% were males and 38.2% were females. (Table 1)

In our study, approximately 54.6% of the patients had peripheral artery disease (PAD) according to the ABI index. Among those with PAD, severity was assessed, with around 71.6% having mild PAD, 21.2% moderate PAD, and 7% severe PAD. The affected limb was also assessed, revealing that 38.9% had bilateral involvement, 35.3% had right-side involvement, and 25.6% had left-side involvement. (Table 2) Among those who tested positive for PAD using the ABI index, about 39 patients had Colour Doppler Ultrasound records. The study revealed that 51.3% of these 39 patients had positive doppler results, while the remaining patients had negative Doppler results. The positive predictive value was found to be 51.3%. (Table 3)

Table 1: Basic details of the participants (N=207)

| Variable | Categories | N | % |
|----------|------------|---------------------|-------|
| Age | Mean (SD) | 58 years (15 years) | |
| Gender | Male | 128 | 61.8% |
| | Female | 79 | 38.2% |

Table 2: Peripheral Artery disease by ABI index

| Variable | Categories | N | % |
|--------------------|------------|-----|-------|
| PAD (N=207) | Yes | 113 | 54.6% |
| | No | 94 | 45.4% |
| Severity (n=113) | Mild | 81 | 71.6% |
| | Moderate | 24 | 21.2% |
| | Severe | 8 | 7% |
| Laterality (n=113) | Right | 40 | 35.3% |
| | Left | 29 | 25.6% |
| | Bilateral | 44 | 38.9% |

Table 3: Peripheral artery disease by ABI Index and Doppler study

| Variable | Categories | Doppler study | | Positive predictive value |
|-------------------------|--------------------|-----------------|-----------------|---------------------------|
| | | Positive result | Negative result | |
| PAD by ABI index (n=39) | Positive ABI index | 20 (51.3%) | 19 (48.7%) | 51.3% |

Discussion

The mean (SD) age of the study participants is 58 years (15 years). About 61.8% were males and 38.2% were females. Studies by Yadav et al., [4] Amulya et al., [5] and Sunaya et al. [1] found that participants were generally above 50 years old, with a higher proportion of males than females. Similarly, a study by Sanjeev et al. [3] showed that the age group was above 40 years, with most participants being male.

In our study, approximately 54.6% of the patients had peripheral artery disease (PAD) according to the ABI index. Among those with PAD, severity was assessed, with around 71.6% having mild PAD, 21.2% moderate PAD, and 7% severe PAD. The affected limb was also assessed, revealing that 38.9% had bilateral involvement, 35.3% had right-side involvement, and 25.6% had left-side involvement.

A study by Sunaya et al. [1] showed that an abnormal ABI was seen in 30% of participants, which is lower than in our study. Among those with abnormal ABI in their study, mild PAD was most common, followed by moderate and severe PAD, similar to our findings. Studies by Sanjeev et al. [3] and Probhu et al. [2] reported abnormal ABI in less than 30% of participants, which is also lower than in our study. Conversely, a study by Amulya et al. [5] found abnormal ABI in around 60% of participants, which is similar to our study.

Among those who tested positive for PAD using the ABI index, approximately 39 patients underwent Doppler study. The study revealed that 51.3% of these 39 patients had PAD, while the remaining patients had negative Doppler results, giving a positive predictive value of 51.3%. In comparison, the study by Sanjeev et al. [3] showed a positive predictive value of 92.85%, the study by Satheesh et al. [6] reported a value of 61.3%, and the study by Amulya et al. [5] found a positive predictive value of 59%, which is similar to our study.

Our study showed lower predictive value of ABI, compared to others. This could be due to factors like difference in patient characteristics and selection bias in those who undergone Doppler study. The Doppler study was not done in all patients, irrespective of ABI positive or negative status. Hence, the estimation of sensitivity and specificity was not possible, limiting the diagnostic potential of colour Doppler. The positive predictive value is around 50%, indicating that ABI <0.9

should prompt further diagnostic evaluation among the patients rather than confirmatory. The clinicians should use ABI as a screening tool and follow up with Doppler studies in asymptomatic or high-risk cases.

Conclusion

The study reveals a substantial prevalence of peripheral artery disease (PAD) among participants, with more than half showing positive findings based on the ABI index. The majority of PAD cases were of mild severity, and bilateral involvement was common. Among the subsets who underwent Doppler evaluation, only about half had confirmatory positive results, indicating a moderate positive predictive value of the ABI for PAD. These findings highlight the importance of early screening and multi-modal diagnostic approaches to accurately assess PAD severity and distribution, which is essential for targeted interventions and management strategies.

Limitation

The limitation of this study is the limited subset of patients with positive ABI were subjected to Doppler. Also, those with negative ABI were not subjected to Doppler. Hence sensitivity and specificity were not calculated. Since, limited patients had doppler results, there may be selection bias in selecting patients for colour doppler ultrasound.

To address these limitations, future research should include the prospective validation of ABI in community and asymptomatic populations to evaluate its utility as a mass screening tool.

Recommendations

Given the high prevalence of PAD among diabetic patients, routine screening using the ABI index in diabetic care settings could help identify PAD early, particularly in high-risk patients, to prevent progression and manage complications.

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