

Use of ABI to detect peripheral arterial disease in diabetes – A recommendation for primary care physicians

Nibedita Mishra

Department of Medicine, Tata Main Hospital, Jamshedpur, India

ABSTRACT

Background: India is considered the diabetes capital of the world. As per current practice, most of the diabetes patients go to primary care physicians for their monitoring and follow up. One of the dreaded complications of long-term diabetes is peripheral arterial disease. **Methods:** A cross-sectional observational study was conducted in a diabetes workshop. Totally, 48 patients were selected who satisfied the inclusion criteria. All were subjected to ankle-brachial index measurement (ABI) and doppler ultrasound was done to assess patency of the lower extremity arteries. The results were compared. The ankle-brachial index of less than 0.99 was considered abnormal. **Results:** Out of a total of 48 included patients 26 patients had normal ABI and 22 patients were found to have abnormal ABI. Out of those with normal ABI, 2 patients had features of peripheral arterial disease proved by doppler, whereas 3 patients with abnormal ABI had no feature of peripheral arterial disease in doppler. MedCalc software was used for statistical comparison. **Conclusion:** In the selected diabetic population prevalence of peripheral arterial disease was found to be 56.25%. Measurement of ABI was found to be quite a sensitive and specific method for diagnosing peripheral arterial disease of diabetics.

Keywords: Ankle brachial index, diabetes complications, doppler ultrasound imaging, peripheral arterial disease

Introduction

Peripheral arterial disease (PAD) is the external manifestation of atherosclerosis. It is characterized by progressive occlusion of arteries of the lower limb and also serves as a marker of thrombosis of other vascular beds.^[1] Diabetes mellitus and smoking are the two most common risk factors for atherosclerotic vascular disease. Other common factors like hypertension, advanced age and hyperlipidemia also play important roles in its pathogenesis.^[1] According to estimates, around 27 million persons have symptoms of PAD in Europe and America and 20% of them have diabetes.^[2] Amongst diabetics, PAD risk is increased in old age, prolonged diabetes and coexistent peripheral neuropathy.^[1]

The prevalence of PAD in diabetics is difficult to assess for several reasons. Many of them are asymptomatic or do not feel it significant enough to report even if having minor symptoms. Pain perception might have been lost due to diabetic neuropathy. There is no uniform screening modality being followed for presence of PAD. To diagnose PAD by the lack of peripheral pulses or symptoms of intermittent claudication will have only a low degree of sensitivity. Hence, a properly validated test like measurement of ankle brachial index (ABI), which is also easily reproducible, will go a long way in estimating the correct prevalence of PAD in diabetics. It is a simple yet non-invasive test to measure quantitatively the patency of lower limb arterial system. To date, measurement of ABI is considered to be one of the most dependable tests for the diagnosis of PAD.^[2] None of the clinical criteria suggested for the diagnosis of PAD are sensitive enough. ABI was found to be 95% sensitive, and also 100% specific when validated against angiography.^[1]

Address for correspondence: Dr. Nibedita Mishra,
Department of Medicine, Tata Main Hospital,
Jamshedpur - 831 001, India.
E-mail: drnibeditamishra@gmail.com

Received: 28-07-2020

Revised: 29-09-2020

Accepted: 28-10-2020

Published: 30-01-2021

Access this article online

Quick Response Code:



Website:
www.jfmpc.com

DOI:
10.4103/jfmpc.jfmpc_1546_20

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Mishra N. Use of ABI to detect peripheral arterial disease in diabetes – A recommendation for primary care physicians. J Family Med Prim Care 2021;10:154-7.

As per current practice in most of India, most of the diabetes patients go to their primary care physicians for monitoring and follow up. We did not find any study from this part of India reporting the prevalence of peripheral arterial disease in diabetics and regarding validity of ABI as a reliable method in diagnosing PAD. Hence this study was taken up. This aims to empower the primary care physicians for early detection of PAD in diabetics and prevention of further complications.

Objectives

To assess the prevalence of PAD in a cross-section of diabetes patients by using ABI measurement and correlate it with Doppler ultrasound (DUS) for the diagnosis of PAD.

Materials and Methods

It was a cross sectional observation, taken during a workshop held for diabetic patients in April 2019 in the out-patient department of the hospital. Permission was granted by the institutional ethical committee for collection of data and subsequent publication. Patients with age more than 50 years and diabetes duration of more than 10 years were included in the study. Among these, persons with pre-existing arterial disease and/or those having history of smoking were excluded. ABI was measured in all these patients following the standard procedure. The patient was made to lie supine with the ankles and arms kept at the same level as of the heart after 5 minutes of rest. Systolic blood pressure was measured in all limbs by the hand-held Doppler device along with a BP cuff and sphygmomanometer. Higher of the two values measured at the ankle was used as the numerator. Higher of the two values measured in the arms was used as the denominator. ABI was calculated using the following formula-

$ABI = \frac{SBP \text{ of posterior tibial artery}}{SBP \text{ of brachial artery}}$

Values between 1.0 and 1.4 are considered to be normal as per Inter-society consensus for management of Peripheral arterial disease (TASC II) guidelines.^[2] Borderline PAD is said to exist when ABI values are between 0.91 and 0.99. Values between 0.9 and 0.4 indicate stenosis in arteries between aorta and ankle. Values less than 0.4 is indicative of severe PAD and more than 1.4 indicate rigid, calcified, and non-compressible arteries.^[3] Color doppler ultrasound was done for all included patients and statistical correlation was established using the MedCalc software [Table 1].

Observation

A total of 300 persons attended the workshop and from this pool, 48 patients satisfied the inclusion criteria. Out of these, 31 (64.5%) were males and 17 (35.4%) were female patients. Twenty-two (45.8%) patients were in the age between 60 and 70 years; 18 patients between 50 and 60 years (37.5%) and only 8 patients were above 70 years of age (16.6%).

Table 1: Statistical Analysis

Parameters	Value	95% CI
Sensitivity	88.89%	70.84%-97.65%
Specificity	90.48%	69.62%-98.83%
Positive Likelihood Ratio	9.33	2.48-35.11
Negative Likelihood Ratio	0.12	0.04-0.36
Disease Prevalence	56.25%	41.18%-70.52%
Positive Predictive Value	92.31%	76.13%-97.83%
Negative Predictive Value	86.36%	68.35%-94.89%
Accuracy	89.58%	77.34%-96.53%

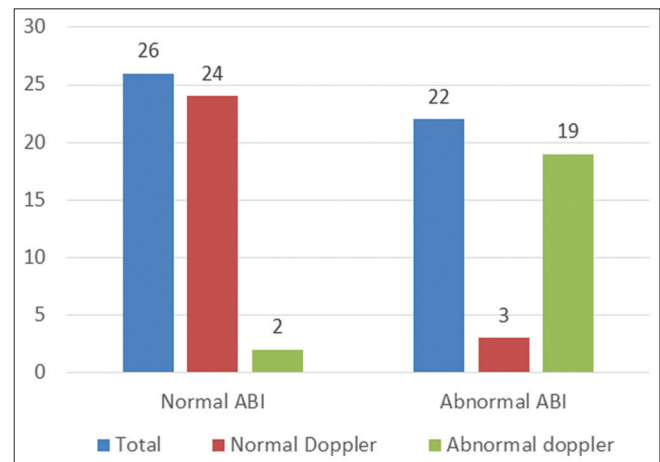


Figure 1: Observation on ABI and Doppler

Out of 48 included patients 26 patients were found to have normal ABI (> 0.99) and 22 patients had abnormal ABI (< 0.99). Out of those with normal ABI, 2 patients had evidence of peripheral arterial disease proved by doppler ultrasound, whereas 3 patients with abnormal ABI had no evidence of peripheral arterial disease in doppler [Figure 1].

Using the MedCalc software, prevalence of peripheral arterial disease in the said group of diabetes patients was found to be 56.25%. Sensitivity of ABI measurement in comparison to DUS was found to be 88.89% and specificity was 90.48%. Positive predictive value of the test was 92.31%, whereas negative predictive value was 86.36%.

Discussion

In the systematic review on effectiveness of bedside investigations for diagnosis of peripheral artery disease, Rachael O *et al.* found that palpation of peripheral pulses was a very unreliable marker and an ABI of less than 0.9 or more than 1.3 appeared to be useful in detection of peripheral arterial disease.^[4] Measurement of ABI, introduced in the late 1960s, is a simple test used to diagnose PAD in clinical settings. Diabetes is one of the major risk factors for PAD. Every 1% increase in HbA1C will raise the risk of PAD by 28% as reported in the UKPDS.^[5] The American Diabetes Association recommended in 2003 to measure ABI in all patients of diabetes more than 50 years of age or in patients having symptoms of PAD or with other cardiovascular risk

factors.^[6] A cross sectional study of 91 diabetic foot ulcer patients in Saudi Arabia showed 21.8% of them had an abnormal ABI and recommended the use of ABI for screening purpose.^[7] Association of different categories of ABI in a large group of type II diabetics over a period of 6 years showed a high incidence of mortality and acute myocardial infarction, suggesting the importance of preventive measures in such persons.^[8] The prevalence of PAD has been recorded in various studies differently. It was relatively lower (13.7%) when only early type II diabetes patients were included who did not have any previously diagnosed complications.^[9] Prevalence was very high (52.5%) when patients of advanced age and prolonged duration of diabetes were included in the study from Nigeria.^[10] Two hundred consecutive patients of type II diabetes in a cross-sectional study at a tertiary hospital in Nigeria revealed the prevalence of PAD to be 38.5%, where a high BMI of more than 25 kg/m² and a low level of HDL were found to be independent clinical correlates of PAD.^[11] Another study of 280 patients having mean age 61.2 ± 7.3 years recorded prevalence of PAD to be 30.7%.^[12] The present study also showed a relatively higher prevalence of PAD i.e., 56.25%, the possible factors responsible being advanced age of participants along with prolonged duration of diabetes in them, minimum criteria being 10 years.

Various authors have compared the sensitivity as well as specificity of ABI measurement in comparison to Doppler Ultrasound while using different methods to calculate the ABI. Homza M *et al.*, compared different methods to acquire ABI and found sensitivity of 67% and specificity of 74.6% while taking the HABP (higher of the ankle pressures), but better values when using the LABP (lower of the ankle pressures).^[13] Dhanowar *et al.* found ABI to be more reliable. The sensitivity was found to be 71.4%, specificity was 97%. The positive predictive value was 83.3% and the negative predictive value was found to be 94.1%.^[14] Gupta *et al.* also found similar values for ABI while comparing to DUS as the gold standard. Sensitivity of ABI was found to be 92.5%, Specificity - 88.33%, Positive Predictive Value (PPV) - 84.09% and Negative Predictive Value (NPV) - 94.64%, respectively.^[15] The sensitivity of ABI measurement in comparison to DUS was found to be 88.89% and specificity 90.48% in the present study, similar to previous studies.

This study aims to empower the primary care physicians with the knowledge about the relatively high prevalence of PAD in diabetics in this region and the reliability of ABI measurement in detecting such cases. The hand held doppler is a relatively inexpensive device which is easy to use and can be used by family and primary care physicians to prevent dreaded complications like amputation in long-term diabetes patients.

Conclusion

The prevalence of peripheral arterial disease in diabetes patients having age more than 50 years and diabetes duration of 10 years or more was found to be 56.25%. Measurement of ABI was

found to be having a strong correlation with doppler ultrasound for assessing the patency of arterial supply of lower extremities. Determination of ankle brachial index was found to be a sensitive and specific method for diagnosis of peripheral arterial disease in diabetics. It is strongly recommended that family physicians and primary care physicians, who deal with the bulk of diabetes patients in the community should have an annual screening for measurement of ABI in such patients in order to detect PAD early as well as prevent dreaded complications like amputation.

Acknowledgement

The author is thankful to the General Manager, Medical Services, Tata Steel, for allowing the manuscript to be published.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. American Diabetes Association. Peripheral arterial disease in people with diabetes. *Diabetes Care* 2003;26:3333-41.
2. Abouhamda A, Alturkstani M, Jan Y. Lower sensitivity of ankle-brachial index measurements among people suffering with diabetes-associated vascular disorders: A systematic review. *SAGE Open Med* 2019 7:2050312119835038. doi: 10.1177/2050312119835038.
3. Fowkes FG, Murray GD, Butcher I, Heald CL, Lee RJ, Chambless LE; Ankle Brachial Index Collaboration et al. Ankle brachial index combined with Framingham risk score to predict cardiovascular events and mortality: A meta-analysis. *JAMA* 2008;300:197-208.
4. Forsythe RO, Apelqvist J, Boyko EJ, Fitridge R, Hong JP, Katsanos K, *et al.* Effectiveness of bedside investigations to diagnose peripheral artery disease among people with diabetes mellitus: A systematic review. *Diabetes Metab Res Rev* 2020;36(Suppl 1):e3277.
5. Adler AI, Stevens RJ, Neil A, Stratton IM, Boulton AJ, Holman RR. UKPDS 59: Hyperglycemia and other potentially modifiable risk factors for peripheral vascular disease in type 2 diabetes *Diabetes Care* 2002;25:894-9.
6. Potier L, Abi Khalil C, Mohammadi K, Roussel R. Use and utility of ankle brachial index in patients with diabetes. *Eur J Vasc Endovasc Surg* 2011;41:110-6.
7. Ababneh M, Al Ayed M Y, Robert A A, Al Dawish M A. Clinical utility of the ankle-brachial index and toe brachial index in patients with diabetic foot ulcers. *Curr Diabetes Rev* 2020;16:270-7.
8. Alves-Cabratosal L, Comas-Cufil M, Ponjoan A, Garcia-Gill M, Marti-Lluch R, Blanch J, *et al.* Levels of ankle-brachial index and the risk of diabetes mellitus complications. *BMJ Open Diabetes Res Care* 2020;8:e000977.
9. do Nascimento SAT, de Freitas FGA, Batista SAGC, Dias RCT, Teixeira DJME, Pires SAG, *et al.* Identification of peripheral arterial disease in diabetic patients and its association with quality of life, physical activity and body composition. *J Vasc Bras* 2015;14:46-54.

10. Oyelade BO, OlaOlorun AD, Odeigah LO, Amole IO, Adediran OS. The prevalence of peripheral arterial disease in diabetic subjects in southwest Nigeria. *Afr J Prm Health Care Fam Med* 2012;4:354.
11. Agboghroma OF, Akemokwe FM, Puepet FH. Peripheral arterial disease and its correlates in patients with type 2 diabetes mellitus in a teaching hospital in northern Nigeria: A cross-sectional study. *BMC Cardiovasc Disord* 2020;20:102.
12. Akalu Y, Birhan A. Peripheral arterial disease and its associated factors among type 2 diabetes mellitus patients at Debre Tabor General Hospital, Northwest Ethiopia. *J Diabetes Res* 2020;2020:9419413. doi: 10.1155/2020/9419413.
13. Homza M, Machaczka O, Porzer M, Kozak M, Plasek J, Sipula D. Comparison of different methods of ABI acquisition for detection of peripheral artery disease in diabetic patients. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2019;163:227-32.
14. Dhanowar RK, Nath L, Tiwari PK. A clinical study of peripheral vascular disease in diabetes mellitus with special reference to ankle brachial pressure index and colour doppler ultrasonography. *Int J Contemporary Med Res* 2016;3:1899-1901.
15. Gupta A, Tyagi VK, Bansal N, Virmani SK, Sirohi TR. Comparison of ankle brachial pressure index to arterial doppler USG in the diagnosis of peripheral vascular disease in diabetes mellitus. *Int J Adv Med* 2017;4:1562-5.