Original Research Article

Comparison of ankle brachial pressure index to arterial doppler USG in the diagnosis of peripheral vascular disease in diabetes mellitus

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ABSTRACT

Background: Peripheral artery disease(PAD) is a major macrovascular complication of diabetes mellitus. Patients with diabetes mellitus have an increased prevalence of PAD. However, due to associated neuropathy, common symptoms such as claudication are often masked and such patients often diagnosed late when limb threatening ischemia has already set in. Arterial colour doppler ultrasonography and ankle brachial pressure index are easy, non-invasive and often underutilised tools for diagnosis of PAD.
Methods: In the present study, 100 diabetic patients were enrolled to study the comparison of Ankle Brachial Pressure Index to arterial doppler USG in diagnosis of peripheral artery disease.
Results: Colour duplex ultrasonography (CDU) was taken as gold standard. Ankle brachial index (ABI) was compared with it. Sensitivity of ABI was 92.50%, Specificity was 88.33%, Positive Predictive Value was 84.09% and Negative Predictive Value was 94.64% respectively.
Conclusions: Peripheral arterial disease (PAD) is very common in patients with diabetes. ABI is a simple and very sensitive test to detect PAD early in these patients.

Keywords: Ankle brachial index, Colour duplex ultrasonography, Diabetes, Peripheral artery disease

INTRODUCTION

Peripheral artery disease (PAD) is defined as atherosclerotic occlusive disease of lower extremities. PAD is associated with increased risk of lower extremity amputation and is also a marker for atherothrombosis in cardiovascular, cerebrovascular and renovascular beds. Additionally, PAD causes significant long-term disability in diabetic patients.[1] The treatment of patients with PAD can therefore be expensive, owing to need for a variety of diagnostic tests, therapeutic procedures, and hospitalizations.[2]

PAD can be clinically identified by intermittent claudication and/or absence of peripheral pulsations in the lower extremities. With the use of doppler technology and ankle brachial pressure index measurement, peripheral artery disease can be identified non-invasively before clinical manifestations.

The measurement of the ankle brachial index (ABI) is a simple test used to document PAD in clinical and scientific settings which was introduced in the late 1960s. It is the ratio of systolic pressures in the lower and upper extremities. Its current pathological value is issued from older studies.1 Ever since, a reduction in ABI is used as a strong indicator of PAD.[2,3]

The ABI is very specific and sensitive technique with 95% accuracy in detecting PAD and an abnormal ABI is

considered as a marker of future cardiovascular disease even in the absence of symptoms. ABI value of >0.9 is considered normal and a value of <0.9 suggests significant disease in one or more arteries of the leg. The majority of patients with claudication have ABIs of less than 0.9.

Despite its high accuracy, several technical questions have been raised about using the systolic blood pressure in calculating the index (ABI) in patients with calcified and incompressible arteries. Diabetic patients who have end-stage renal disease and those senior diabetic patients are able to give normal or falsely elevated ABI (value: 1.3-2). Therefore, using their data nullifies the value of the test for diagnosis and follow-up.

Catheter angiography (CA) is recommended as the reference standard in the diagnosis of PAD. However, the potential disadvantages of this method include requirement of vascular access, risk of ionizing radiation and exposure to contrast agent. Magnetic resonance angiography (MRA), computerized tomography angiography (CTA) and Doppler US are the currently the alternative imaging methods. Although, these tools are less invasive compared to CA, concerns related to the use of ionizing radiation still remain with CTA. In addition, the use of contrast substance has potential risks in angiography performed with CTA or MRA. However, performing Doppler ultrasonography possess neither of these risks. Therefore, it is important to examine the true value of the Doppler US in the diagnostic examination of PAD in the lower limbs.

Peripheral vascular disease is a major macrovascular complication of diabetes mellitus.[3] Because of the unique involvement of distal pattern of vessels and invariable association with neuropathy, peripheral arterial disease has a greater prevalence in diabetics, it presents late, having already developed limb threating ischaemia.[4] In the present study, 100 patients with diabetes mellitus were enrolled and underwent ankle brachial index(ABI) measurement and colour duplex ultrasonography (CDU) to compare the two methods for diagnosis of peripheral artery disease.

METHODS

The study was a prospective observational study carried out at a tertiary care teaching hospital.100 patients fulfilling the inclusion and exclusion criteria were studied.

Inclusion criteria

All aged patients diagnosed with Diabetes Mellitus by ADA 2014 criteria.[3]

- HbA1c > or = 6.5%
- Fasting Plasma Glucose > or = 126 mg/dl (fasting is defined as no caloric intake for > or = 8 hrs).

- 2 hr Post Prandial Plasma Glucose > or = 200 mg/dl during Oral Glucose Tolerance Test (with 75g glucose).
- Random Plasma Glucose > or = 200 mg/dl. In persons with symptoms of hyperglycemia or hyperglycaemic crisis.

Exclusion criteria

- Limb amputation proximal to head of metatarsal of one or both lower limb and amputation proximal to wrist of one or both arms.
- Limb wounds or ulcerations proximal to metatarsal head in the lower limb.
- Prior bypass surgery to the lower limb arteries.
- Acute limb ischemia on cuff inflation.
- Not consenting to participate in the study.

A written consent was taken from all potentially eligible subjects. Detailed history and physical examination was performed and recorded on predesigned proforma from each patient. Patient's personal history, physical examination findings were recorded.

A resting ABI of each lower limb was determined in supine position using a portable Doppler machine with a 5-8MHz probe for peripheral vessels. Blood pressure cuffs were placed on the upper arm (brachial pressure) and at the ankle just above the medial malleoli. Patients also underwent colour duplex ultrasonography(CDU) for diagnosis of peripheral artery disease which was taken as the gold standard to compare the value of ABI in diagnosis of PAD.

Statistical analysis was done using SPSS version 20.0.

RESULTS

Ankle-brachial index (ABI) examination of patients indicated Abnormal (ABI= <0.9), in 40 cases.

Right side was abnormal in 35 cases, Left side was abnormal in 38 cases and 33cases were bilaterally abnormal. As for normal (ABI= >0.9) cases, Right side was normal in 65cases, Left side was normal in 62 cases, and 60 cases were bilaterally normal. Total normal ABI cases were 60 only (Table 1).

Table 1: Distribution of ABI of studied patients.

ABI	Right limb	Left limb	Bilateral	Total
Abnormal (ABI= <0.9)	35	38	33	40
Normal (ABI= >0.9)	65	62	60	60
Total	100	100	-	100

While 40 (40%) patients were afflicted with Peripheral arterial disease (PAD) using ABI for measurement, 60 percent others were free from PAD

Results of the color duplex ultrasonography (CDU) examination of patients are indicated in the Figure 1. Right side abnormality was observed in 39 cases, Left side abnormality was observed in 41 cases and 36 cases were bilaterally abnormal. Total abnormal CDU cases were 44. As for normal (CDU) cases, Right side was normal in 61cases, Left side was normal in 59 cases and 56 cases were bilaterally normal. Total normal CDU cases were 56.

Correlation between CDU and ABI between peripheral and non-peripheral vascular disease patients is indicated in Table 2.

Table 2: Correlation between CDU and ABI of studied patients.

		ABI		Total
		PVD	NPVD	
CDU	PVD	37	7	44
	NPVD	3	53	56
	Total	40	60	100

Statistical Sensitivity, Specificity and also positive and negative predictive values of ABI in diagnosis of PAD patients is indicated in the Table 3.

Table 3: Statistic sensitivity, specificity as also positive and negative predictive values of ABI in diagnosis of PAD patients.

Statistic	Value	95% CI
Sensitivity	92.50%	79.61% to 98.43%
Specificity	88.33%	77.43% to 95.18%
Positive Predictive Value	84.09%	72.38% to 91.43%
Negative Predictive Value	94.64%	85.56% to 98.14%
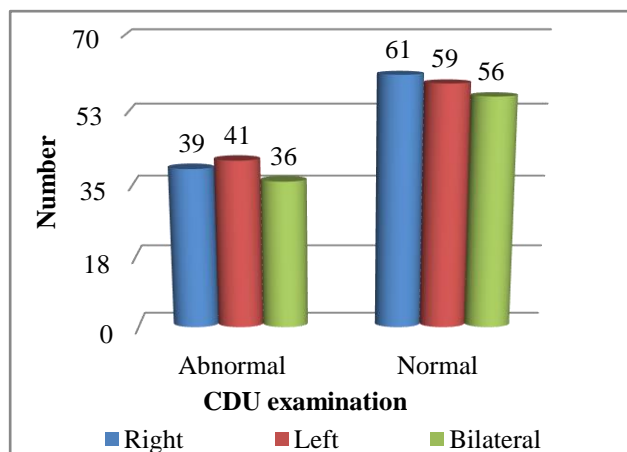
Figure 1: Distribution of CDU of studied patients.

DISCUSSION

Cardiovascular diseases (CVD) are a major cause of morbidity and mortality in adult patients with diabetes mellitus (DM). Macro vascular complications like stroke, myocardial infarction and PAD tend to occur earlier in diabetics compared to non-diabetics.[4]

PAD is a manifestation of widespread systemic atherosclerosis characterized by atherosclerotic occlusive disease of the lower extremities and is one of the macro vascular complications highly prevalent in adult diabetic patients. The majority of diabetic patients with PAD have concomitant coronary artery disease, and a significant burden of morbidity and mortality in these patients is intimately associated with myocardial infarction, ischemic stroke or sudden cardiovascular death.[5-7]

The noninvasive techniques like Ankle Brachial Pressure Index (ABI) and Duplex ultrasonography are coming to the forefront for early diagnosis of PAD. ABI is the ratio of the peak systolic pressure in the ankle and brachial artery. It is a quick, reliable and sensitive method to detect subclinical disease.[8]

Screening for PAD by measuring the ABI, which is the ratio of the tibial systolic artery pressure to brachial systolic artery pressure is preferred to clinical inspection of lower limbs and palpation of the feet pulses. ABI measurement is a non-invasive procedure performed using a Doppler ultra sound device and has a 95% sensitivity and 100% specificity for diagnosing PAD compared to the gold standard angiography. An ABI of less than 0.9 is diagnostic of PAD. The normal range is between 0.9 and 1.1 while values ≥1.3 signify non-compressible or calcified peripheral arteries.[9]

Peripheral vascular disease is common in diabetic patients and is responsible for a substantial proportion of morbidity in Diabetes. The purpose of this study was to study the clinical features of PAD in patients with DM and then to investigate the comparison of ABI to gold standard CDU in patients with DM. Present study shows prevalence of PAD was 40 (40%) in diabetic patients using ABI measurement.

ABI < 0.9 was the cut off used to define PAD in the present study. Correlation between CDU and ABI between peripheral and non-peripheral vascular disease patients is indicated in the Table 2. While as per colour duplex ultrasonography (CDU) examination patients with Peripheral vascular disease (PAD) were 44 their number was 37 only as per Ankle-brachial index (ABI) examination. Thus 7 patients would not have been diagnosed if ABI was used alone for diagnosis of PAD. Similarly, non-peripheral vascular disease patients were 56 as per colour duplex ultrasonography (CDU) examination their number was only 53 as per Ankle-brachial index (ABI) examination. The sensitivity value of ABI was found to be 92.50% and specificity was

88.33%. The positive predictive value of ABI was found to be 84.09% and the negative predictive value was 94.64 %. Earlier studies have suggested ABI as a reliable method for diagnosis of PAD and ABI value of <0.9 has a sensitivity of 95% compared to angiography. ABI has also been considered as a marker for increased risk of systemic vascular disease and has been shown to be a good predictor for coronary artery disease. Recent improvements in the field of imaging have introduced CDU scanning for diagnosis of PAD. The Doppler technology is very helpful for detection and grading of atherosclerotic plaques in the arteries.

Rajesh Kumar Dhanowar et al reported the sensitivity of ABI as 71.4% and specificity is 97% and positive predictive value of ABI was found to be 83.3% and the negative predictive value was 94.1%.[10] Premalatha G et al reported a specificity and sensitivity for ABI as 88.5% and 70.6% respectively. The positive predictive value in their study was 94.1% and- the negative predictive value was 53.4% in their series.[11] Using CDU as a reference method, William et al. showed in a group of diabetic patients with an intermediate vascular profile and without neuropathy that an ABI <0.9 had a sensitivity of 100% and a specificity of 88%. The results in the non-diabetic control group were almost similar (sensitivity 83% and specificity 100%).[12] Alnaeb et al. reported a correlation of −0.81 between an ABI <0.9 and arterial DUS in the same type of diabetic patients.[13]

CONCLUSION

From the present study it can be concluded that peripheral vascular disease in Diabetes Mellitus is more commonly associated than is generally believed. Atherosclerosis of the peripheral vessels is also associated with generalised atherosclerotic changes in the coronary and vascular beds. It is also associated with significant mortality and morbidity. Hence early detection of peripheral vascular diseases should be attempted to evaluate a proper treatment guideline for patients with diabetes.

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