To Study the Sensitivity and Specificity of Ankle Brachial Index in Diagnosis of Peripheral Arterial Disease in Diabetics with Coronary Artery Disease at a Large Tertiary Care Teaching Hospital

By Dr. Sajad Hussain Bhat, Dr. Adil Majeed, Dr. Mohd Yousuf Dar & Mohd Yousuf Dar

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Materials and methods: All diabetic patients admitted with coronary artery disease who undergo coronary angiography irrespective of their presentation (stable angina, unstable angina, NSTEMI, STEMI) were included in the study. Systolic blood pressures of both arms at the brachial arteries and both lower limbs at the dorsalis pedis arteries were taken with the help of sphygmomanometer and a hand held doppler probe and recorded in the proforma. The higher of the two systolic pressures recorded at the ankle was divided by the highest of the systolic pressures recorded in the arms to get the ankle brachial index. The results of ABI were compared with peripheral angiography.

Keywords: ABI; ankle brachial Index: PAD; peripheral arterial disease.

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Results: Among the total of fifty (50) patients in the study group 80% (n=40) had a normal peripheral angiography while 20% (n=10) had an abnormal angiography. Out of the affected patients 4% (n=2) had plaquing and 16% (n=8) had stenosis of the peripheral arteries. The sensitivity, specificity, positive predictive value and negative predictive value of ABI by hand held doppler apparatus was found to be 90%, 97.5%, 90% and 97.5% respectively.

Conclusion: Ankle Brachial Index is a useful non invasive diagnostic modality for peripheral artery disease in diabetic patients with concomitant coronary artery disease.

Keywords: ABI; ankle brachial Index: PAD; peripheral arterial disease.

I. Introduction

Measurement of ankle brachial index (ABI) is useful for detecting peripheral arterial disease (PAD) and identifying persons at risk for future atherothrombotic events. The likelihood of symptomatic progression of PAD is lower than succumbing to coronary artery disease (CAD). Approxmiately 75 – 80% of non diabetic patients who present with mild to moderate claudication remain symptomatically stable. Deterioration is likely to occur in the remainder with approxmiately 1 -2 % of the group ultimately developing critical limb ischaemia each year. Approxmiately 25–30% of patients with critical limb ischaemia undergo amputation within one year. The prognosis is worse in patients in patients who continue to smoke cigerates or who have diabetes millets. Although much is known regarding PAD in general population the assesment and management of PAD in those with diabetes is less clear and posess some special issues. At present there is no established guidelines regarding the care of patients with both diabetes and PAD[1]. The highest prevalence of atherosclerotic PAD occurs in the sixth and seventh decades of life. The true prevalnce of PAD in people with diabetes has been difficult to determine as most patients are assymtomatic, many do not report their symptoms, screening modalties have not been uniformly agreed upon, and pain perception may be blunted by the presence of peripheral neuropathy. For these reasons a patient with diabetes and PAD may be more likely to present with an ischemic ulcer or gangrene than a patient without diabetes. While amputation has been used by som as a measure for PAD prevalence, medical care and local indication for amputation verses revascularisation of the patient with critical limb ischemia widely vary. Thus amputation may be an imprecise measure of PAD.

The reported prevalence of PAD is also affected by the methods by which the diagnosis is sought. Two commonly used tests are the absence of peripheral pulses and the presence of claudication. Both however suffer from insensitvity. A more accurate estimation of the prevalnce of PAD in diabetes should rely upon a validated and reproducible test. Such a test is the ankle brachial index(ABI) which involves measuring the systolic pressure in the ankles (dorsalis pedis and posterior tibial arteries) and arms (brachial arteies) using a hand held doppler and then calculating the ratio. Simple to pesimple to perform it is non invasive, quantitative measurement of the patency of the lower extremity arterial systm. Compared with an assesment of pulses or a medical history the ABI has been found to be more accurate. It has been validated against angiographically confirmed disease and found to be 95% sensitive and almost 100% specific[2-4]. ABI also serves as a marker of cardiovascular risk.[5] Angiography is the gold standard for vascular imaging in PAD. It is primarily indicated for anatomical evaluation of the

patient in whom a revascularisation procedure is intended. It is an invasive test and there I a small risk of contrast induced nephrotoxicity, allergic reaction to the contrast medium, thrombosis and embolism. For patients with suspected pedal ischemia the angiography should include an aortogram with selective unilateral run off and a magnified lateral view of foot. It should be noted that decision to perform an aortogram is made on a clinical basis and need for revascularisation.

In contrast to the variability of pulse assesment and the often non specific nature of inflamation obtained via history and other components of the physical examination, the ABI is a reproducible and reasonbly accurate, non invasive measurement for the detection of PAD and the determination of disease severity. The diagnostic critaria for PAD based for PAD based on ABI are interpreted as follows:[6]

Normal if 0.91 – 1.30
Mild Obstruction – 0.70 – 0.90
Moderate obstruction if 0.40 – 0.69
Severe obstruction if <0.40
Poorly compressible if >1.30

II. Materials and Methods

The present study was a hospital based cross sectional study conducted in the postgraduate department of cardiology at Sher i Kashmir institute of medical sciences Soura. The present study was carried for a period of one year from 1st october 2014 to 30th September 2015.

a) Study population

All diabetic patients admitted with coronary artery disease who undergo coronary angiography irrespective of their presentation (stable angina, unstable angina, NSTEMI, STEMI) were included in the study.

b) Exclusion criteria

1. Patients with coronary artery disease without diabetes
2. Diabetic patients without coronary artery disease
3. Patients on vasodilators
4. Chronic kidney disease patients

After taking informed consent to participate in the study, Information regarding demographics, co morbidity, past history and family history was collected. Patients were interviewed and clinical profile of patients including risk factors of coronary artery disease like diabetes, hypertension, smoking, dyslipidemia, obesity and family history of coronary artery disease were assessed and recorded in the proforma. Investigations both non- invasive and invasive including coronary and peripheral angiography were done. Systolic blood pressures of both arms at the brachial arteries and both lower limbs at the dorsalis pedis arteries were taken with the help of sphygmomanometer and a hand held doppler probe and recorded in the proforma. The higher of the two systolic pressures recorded at the ankle was divided by the highest of the systolic pressures recorded in the arms to get the ankle brachial index. The results of ABI were comapered with peripheral angiography.

The responses obtained on the questionnaires were converted into data over a Microsoft excel sheet. The variables of interest have been shown in term of frequency and percentages. The standard statistical test, Pearson's chi square test has been used to analyze the data. All the results so obtained were discussed at 5% level of significance (p-value<0.05). Also the appropriate statistical charts have been used to represent the results. SPSS V 20 has been used to analyze the data.

III. Results

During the study period of two years after carefully considering inclusion and exclusion criteria, fifty (50) patients were enrolled in the study. Of the patients males were 37(74%) and 13(26%) were females with a male female ratio of 2.85:1. The mean age of the patients was with a range of 55.6+8.2 and mean duration_of diabetes was 6.8+8.4 years. Out of fifty patients in the study, 32%(n=16) were <50 yrs of age, 36%(n=18)were between 50-60 yrs of age, 32%(n=16) were above 60 yrs of age.

Table 1: Age Distribution

Age	Frequency	Percentage
< 50 yrs	16	32.0
50 – 60 yrs	18	36.0
>60 yrs	16	32.0
Total	50	100.0

Out of fifty (50) patients in study group 74% (n = 37) were males and 26% (n=13) were females.

Table 2: Sex Distribution

Gender	Frequency	Percent
Male	37	74
Female	13	26
Total	50	100.0

Among the total of fifty(50) patients in the study group 80% (n=40) had a normal peripheral angiography while 20% (n=10) had an abnormal angiography. Out of the affected patients 4% (n=2) had plaquing and 16% (n=8) had stenosis of the peripheral arteries.

Table 3: Number of patients with PAD on peripheral angiography

PAD	Frequency	Percent
Normal	40	80
Plaqueing	2	4
Stenosis	8	16
Total	50	100.0

Out of 10 patients having PAD 2% (n=1) were <50yrs of age, 4% (n=2) were between 50-60 yrs of age and 14% (n= 7) of the patients were above 60 yrs of age. The results were statistically significant in relation to age of patients (p = 0.014).

Table 3: Relationship between age and peripheral arterial disease

Age	Peripheral angiography		Total	P value
	Positive	Negative		
<50	1	15	16	
50 - 60	2	18	18	0.014
>60	7	9	16	
	10	40	50	
Total	100%	100%	100%	

Out of ten (10) affected patients, 70% (n=7) were males and 30% (n=3) were females. The relation between sex and PAD was not statistically significant (p= 0.707).

Table 4: Showing gender wise frequency of PAD

		Peripheral Angiography		Total	P Value
		Positive	Negative		
Sex	Male	7	30		
		70%	30%		
	Female	3	10		0.707
		30%	25%		
Total		10	40		
		100%	100%		

Among the angiographically proven PAD patients, 10%(n=1) had no obstruction on hand held doppler device, 20%(n=2) had mild obstruction (ABI = 0.70 – 0.90) and 70%(n=7) had moderate obstruction (ABI= 0.04 – 0.069). None of the patients had severe obstruction (ABI=<0.40) on doppler device.

Table 5: ABI in patients with peripheral arterial disease

ABI	NORMAL	1
	MILD	2
	MODERATE	7
Total		10

Among the patients with normal ABI 2% (n=1) had plaqueing with no stenosis on peripheral angiography while among patients with mild obstruction, 2%(n=1) had plaqueing and 2% (n=1) had arteial stenosis. Among the patients with moderate obstruction all the patients14% (n=7) had arterial stenosis.

Table 6: Comparing peripheral angiography results with ABI

		PERIPHERAL ANGIOGRAPHY			TOTAL
		PLAQUEING	STENOSIS	NORMAL	
ABI	NORMAL	1	0	39	40
	MILD	1	1	1	3
	MODERATE	0	7	0	7
TOTAL		2	8	40	50

In our study 10%(n=1) of patients with PAD were labelled normal by doppler calculated ABI while as in non – PAD group, 2.5 % were labelled as having PAD. The sensitivity, specificity, positive predictive value and negative predictive value of ABI by hand held doppler apparatus was found to be 90%, 97.5%, 90% and 97.5% respectively.

Table 7: Sensitivity, Specificity, Positive predictive value and Negative predictive value of ABI

ABI VS PERIPHERAL ANGIOGRAPHY				
		Peripheral Angiography		Total
		Plaqueing/ stenosis	Normal	
ABI	Obstruction	9 True Positives (a)	1 False positives (b)	10 a + b
	Normal	1 False Negatives (c)	39 True Negatives (d)	40 C + d
Total		10 (a + c)	40 (b + d)	50 (a + b + c+d)

Sensitivity = a/a + c = 9/ 9 + 1 = 0.90 =90%
Specificity= d/b + d = 39/39+1 = 97.5%
Positive predictive value = a/ a + b = 9/9+1 = 0.90 = 90%
Negative predive value = d/ c + d = 39/ 39 + 1 = 0.975 = 97.5%

IV. Discussion

The present study was a hospital based study conducted in the postgraduate department of cardiology, Sher i kashmir institute of medical sciences Soura Srinagar. In this prospective study fifty(50) type 2 diabetes patients admitted with CAD were studied whose mean age was 55.6 ± 8.2 and mean duration of diabetes was $6.8+8.4$. Not much of the research is currently available on the assessment of PAD in diabetic patients with concomitant CAD. Most of the studies in diabetic patients focus on assessment of CAD with or without other neurovascular complications. The study group included diabetic patients with CAD irrespective of their presentation as stable angina, unstable angina, NSTEMI, and STEMI. In the present study the prevalence of angiographically detected PAD was found to be 20%. Excluding four(4) patients with normal coronary angiography the actual prevalence of PAD in patients with concomitant CAD was equal to 21.73%. A K Agarwal et al found the prevalence of PAD to be 26% in their study of 146 patients with CAD[7].

Among the angiographically proven PAD patients 10%(n=1) had no obstruction, 20% (n=2) had mild obstruction(ABI=0.70 – 0.90) and 70% (n=7) had moderate obstruction(ABI = 0.70 – 0.90) by using hand held doppler devic. None of the patients had severe obstruction (ABI = <0.40) on doppler device. In our study 10% of patients with PAD were labelled normal by Doppler calculated ABI index while as in non PAD group 2.5% were labeled as having PAD. The sensitivity, specificity, positive predictive value and negative predictive value of ABI by hand held Doppler apparatus was found to be 90%, 97.5%, 90% and 97.5% respectively. Heather Spencer Feigelson et al in their study screened 421 normal subjects and 63 subjects with large vessel PAD. Segmental blood pressure ratios and flow velocities by Doppler ultrasound were used to define cases of large vessel PAD[8]. The sensitivity, specificity, positive predictive value and negative predictive value of each individual diagnostic algorithm were determined. Overall measurements of posterior tibial artery flow showed the highest sensitivity, specificity, positive predictive value and negative predictive value and overall accuracy. It was found that ABI < 0.80 yielded a test with sensitivity of 89%, specificity of 99%, positive predictive value of 90%, negative predictive value of 99%. The results are reasonably comparable to our study.

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