Original Research Article

A study to correlate arterial doppler sonography with ankle branchial index among diabetics and hypertensive in tertiary care hospital

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Abstract

Background and Objectives: Diabetes and hypertension are common causes of peripheral arterial disease. It is important to diagnose peripheral arterial disease at its earliest and start treatment to prevent complications. Ankle brachial index is a non invasive and easy method to diagnose peripheral arterial disease. Our objective is to compare ankle brachial index with arterial doppler sonography, to determine the relationship between ankle brachial index with the duration and severity of peripheral arterial disease in diabetics and hypertensives. **Methods**: A study is a hospital based prospective study. We measured ABI in all patients referred to us for arterial doppler sonography who are diabetics and hypertensives. **Results**: There is strong correlation between ABI and arterial doppler sonography. The severity of lower limb arterial disease increases with the duration of diabetes and hypertension. The duration and severity of PVD can be calculated by ABI. ABI has a sensitivity of 88.64% and a specificity of 90.62% in diagnosing peripheral arterial disease. **Interpretation and Conclusion**: BI can be used as an effective screening tool for peripheral arterial disease.
Key Word: ankle brachial index, lower limb ischemia

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INTRODUCTION

Two interrelated and often co-occurring chronic diseases exemplify the complexity of India's health transition: Diabetes and hypertension. Each of these diseases presents a comparable epidemiological profile: rising prevalence, particularly among the urban population. Epidemiological studies show that there is a rise in the prevalence of diabetes – by 2025, the diabetic population, already the largest in the world, will double reaching more than 57 million. A National Urban Survey in 2000 observed that the prevalence of diabetes in urban India in adults was 12.1 percent. People with diabetes are prone to develop peripheral neuropathy, peripheral arterial disease, nephropathy and retinopathy[1]. There is a similar rise in the prevalence of hypertension. Hypertension is the most common cardiovascular disease, emerging as a major public health problem in developing as well as developed countries. The WHO report 1998 states that considering the prevalence of any disease, hypertension ranks fourth in the world. Hypertension is a significant public health problem in urban and rural areas of India. Hypertension is a leading cause of blindness, renal failure and congestive heart failure. The overall prevalence of hypertension was calculated to be 7.24%[2]. Both hypertension and diabetes are directly responsible for majority of stroke deaths and coronary heart deaths in India[2]. Because of the changing life style, the environment, industrialization, and urbanization the prevalence of diabetes and hypertension are increasing constantly. Hence early diagnosis and treatment of complications is very important to decrease the rate of morbidity and mortality in these patients. An ankle brachial index (ABI) test is the least invasive test to get and initial diagnosis of arterial disease in the lower

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extremities. This test measures blood pressures at the ankle and in the arm. The ABI test can be supplemented with arterial Doppler whenever necessary. The present study is undertaken to validate the ankle brachial index measurement for the assessment of the severity of lower limb ischemia. The measurement is easy to take and can therefore be easily incorporated into the protocol for screening of lower limb ischemia.

METHODOLOGY

The study is a hospital based prospective study of comparison of ankle brachial index and Doppler sonography in patients with diabetes and hypertension. The study period was for duration of 12 months from November 2016 to Novermber2017. 120 subjects were included in the study after following inclusion and exclusion criteria

Inclusion criteria: Patients with diabetes and hypertension.

Exclusion criteria: Severely calcific vessel wall at the site of cuff application on the lower leg. Patients with cerebrovascular disease. Ulcers at the site of application of the cuff. The study includes three groups of patients – having only diabetes, only hypertension and with both diabetes and hypertension. They are referred from various departments of GIMS, Gadag, hospital to the radiology department for lower limb arterial Doppler. Subjects were selected with a procedural clinical diagnosis of diabetes and/or hypertension. The laboratory parameters such as blood glucose levels, serum creatinine etc. were recorded. A detailed history of the patients was collected which included type and duration of disease, family history, history of smoking or alcohol, history of previous surgeries, type and number of medications and other associated ailments.

METHOD OF COLLECTION OF DATA

Lower limb arterial doppler was done using linear array probes with a frequency of 7 MHz or higher for B-mode, and 5 MHz or higher for doppler for assessment of detailed flow velocity maps of both lower limb arteries and to look for atheromatous plaques, stenosis, occlusion(thrombosis, emboli) and collaterals. The arteries which were evaluated included infra renal abdominal aorta, common iliac arteries at origin, external iliac arteries just proximal to the inguinal ligament, common femoral arteries proximal to bifurcation, superficial femoral arteries – proximal and distal portions, popliteal artery at popliteal fossa, anterior and posterior tibial arteries – at upper leg and at ankle and dorsalis pedis artery at origin. The peak systolic and end diastolic velocities, PI, RI and S/D ratio were measured. The spectral pattern was noted. The ankle brachial index is a noninvasive test performed with a blood pressure cuff and a Doppler machine that identified flow within the vessel lumen. Individuals are tested in the supine position following a 5 – minute rest period. Initially, brachial systolic blood pressure is recorded by inflating the blood pressure cuff above the elbow. The Doppler probe is coupled to the skin over both brachial arteries with ultrasound gel. The probe should be held at a 45-degree angle that opposes the direction of brachial artery blood flow. The cuff is slowly deflated after the brachial artery has been occluded and the pressure at which the pulse sound returns is recorded as a brachial systolic pressure. Systolic pressure is measured in each arm two times and the highest value is used in the ABI calculation. Following the brachial recording ankle systolic pressure is recorded by inflating the cuff approximately 5 cms above the medial malleolus and listening for vascular occlusion with Doppler probe placed over the posterior tibial and dorsalis pedisarteries in turn. The cuff is slowly deflated and the pressure at which the pulse sound reappears is recorded as an ankle systolic pressure. After two posterior tibial or dorsalis pedis artery measures on each side, the highest systolic value is used in the ABI calculation. The ABI is calculated by dividing ankle systolic pressure by brachial systolic pressure.

Statistical analysis: Data entry and management was done in excel, pre-determined data format have been introduced as datasets which was incorporated into a single master computer at the base. The data sets were transferred into SPSS after data cleaning and recoding with data definitions. The Statistical software namely SAS 9.2, SPSS 19.0, Stata 10.1, were used for the analysis of the data. Yield of performing ankle brachial index was calculated.

Equipment Used: Voluson 730pro Sphygmomanometer (Using A 10–12 Cmcuff) Siemens Sonolineg50 Phillips Hd11 Sonosite

RESULTS

Out of 120 cases, 40 patients had only diabetes, 32 patients had only hypertension and 48 patients had both. The age group of 120 patients included in the study range from 32 to 87 years with the mean age of 49.21 $\pm$ 16.45 years.

Table 1: Distribution of subjects according to sex

Sex	Diabetics	Hypertensives	Both	Total
Male	25	20	34	79
Female	15	12	14	41
Total	40	32	48	120

Out of 120 subjects 79 (65.83%) were male and 41 (34.17%) were female.

Table 2: Distribution of subjects according duration of diseases.

Duration	Diabetics	Hypertensives	Both	Total
3-5yrs	20	19	24	63
6-8yrs	9	6	16	31
9-11yrs	11	7	8	26

Table 3: Distribution of subjects according lower limb arterial disease by arterial Doppler vs ABI

		Arterial Doppler		Total
		Present	Absent	
ABI	Present	78	3	81
	Absent	10	29	39
	Total	88	32	120

Table 4: Diagnostic accuracy of ABI in recognizing an abnormal study in diabetics and hypertensives with arterial Doppler as standard

Features	Value	95% confidence interval (CI)
Sensitivity	88.64%	80.09% to 94.41%
Specificity	90.62%	74.98% to 98.02%
Positive predictive value	96.30%	89.83% to 98.71
Negative predictive value	74.3%	61.55% to 84.01%
Accuracy	89.17%	82.19% to 94.10%

DISCUSSION

Atherosclerotic Disease is the third leading cause of death after cardiac pathologies and cancer in the developed countries 3. Critical lower limb ischemia can cause morbidity and mortality, hence it is essential to diagnose atherosclerotic disease early and the disease progression can be prevented by medical therapy and physiotherapy. Diabetes and hypertension are the leading causes of lower limb atherosclerotic disease in the world[4]. Angiography is considered the gold standard 5, but is invasive and expensive and involves significant risk to the patient(0.1%, major complications occur in 0.7% of the cases, with a 0.16% mortality rate) 6,7. Among the non-invasive methods arterial doppler has a high sensitivity and specificity for diagnosis and characterization of peripheral arterial disease[8,9]. It is easy to perform, does not have adverse effects on the patient and is accurate in diagnosis, with rates almost similar to that of angiography. However doppler requires considerable expertise to perform and is time consuming. Ankle brachial index is a non invasive method to diagnose peripheral arterial disease. It does not require expensive equipment or expertise to perform. It is more easily available compared to Doppler sonography and takes a shorter duration of time to perform. It can be performed even in primary health centers and in rural settings. Ankle brachial index can be performed either by using a doppler machine or using a stethoscope. A study done by Carmo *et al*9 comparing both these methods and concludes that ABI performed using a stethoscope has similar predictive values as compared to ABI performed using the Doppler probe. This study is done to prove the effectiveness of ankle brachial pressure index in the identification of peripheral arterial disease in diabetes and hypertensives with results comparable to that of Doppler sonography. In this study the ankle brachial index is performed using the Doppler probe. The results of which can be extrapolated to ankle brachial index performed by stethoscope 10. And this can be used as an effective diagnostic tool in rural settings where Doppler is unavailable. According to our study ABI has a sensitivity of 88.64%, specificity of 90.62%, positive predictive value of 96.30%, negative predictive value of 74.36% and accuracy of 89.17%. Our results were comparable with the study done by Carmo *et al* 10. The positive predictive value of ankle brachial index calculated by our study is greater than in their study(PPV–62.5). The sensitivity of ABI calculated by our study is lower than that calculated in the study done by Hummel *et al* 11 (sensitivity of 91.2% and specificity of 92 %). They calculated the ankle brachial pressure index by tread mill exercise testing and reactive hyperemia methods in patients with a normal resting ABI and correlated it with conventional angiography. This is particularly useful in patients having intermittent claudication and a normal resting ABI. We excluded all patients with arterial calcification. Severely calcified vessels show an abnormally high ABI more than 1.3 leading to false negative results. The severity of peripheral arterial disease can be predicted by an abnormal ABI because of the strong correlation between the Doppler and ankle brachial index findings. Thus ABI is an effective screening tool for peripheral vascular diseases. However an abnormal ABI should be supplemented by arterial Doppler if available for exact localization of the disease and evaluation of flow velocity, resistive index and spectral pattern, also for the evaluation of collateral circulation. These cannot be determined by ABI and hence are its limitations. Thus ABI has a high diagnostic value, but a low therapeutic value. However calculating segmental blood pressure may help in localizing the site of the lesion 12. Some limitations of our study include reproducibility of ABI calculation which was not performed. However, another study evaluated the reliability of Doppler ABI by three Different observer groups and, according to it, there are only small differences and no systematic bias between the three groups, which makes it safe and reliable 10. Their inference can be extrapolated to our study. Another limitation of our study is the lack of follow up of the patients evaluated and their clinical outcome. However our objective was to show that ABI was an effective screening tool for peripheral vascular diseases which proved by obtaining results similar to that by Doppler sonography. Finally we studied a hospital population

which may not be similar to that in a primary care center or rural area. Since the incidence of PAD may be significantly different between these two populations.

CONCLUSION

According to our study, the ABI is a useful method to exclude PAD and it may be suitable for screening in the primary care setting. An abnormal ABI can predict the duration and severity of arterial disease with results similar to arterial Doppler. However, more studies are necessary for further confirmation and to establish the prognostic value of the ABI.

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