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Comparison of Lower Limb Arterial Pulsatility and Ankle Brachial Indices (PI and ABI) in Diabetic Subjects with and Without Neuropathy

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Abstract:

Objectives: This study was performed to find out the extent and nature of arterial flow abnormality in diabetic patients with peripheral neuropathy compared to diabetic patients without neuropathy, using duplex colour Doppler technique.

Materials and method: This cross sectional study was performed on diabetic subjects in the Department of Radiology and Imaging, BIRDEM from July 2008' to May 2009. Patients were referred from Department of neurology and preventive foot care OPD, BIRDEM, for colour Doppler imaging of lower limb arteries. Total 88 consecutive diabetic patients were included in this study. Out of them 48 were diagnosed cases of diabetic neuropathy (group I) and 40 were diabetic without neuropathy (Group II). In all patients the Ankle Brachial Index (ABI) and Pulsatility Index (PI) were recorded on both left and right lower limb arteries, by using duplex colour Doppler technique. Total no. of patients were 88. 48 had neuropathy. They were 27-57 yrs of age. Result: Unpaired't' test was used to find out relationship between the variables.P value <o.o5 was considered as statistically significant. The mean ABI was 1.44±0.07, ranged from 1.30 to 1.59 in group I (diabetic neuropathy) and 1.17±0.06, ranged from 1.05 to 1.26 in group II (diabetic without neuropathy). The mean ABI difference was found statistically significant (p<0.05) between group I and group II. The mean PI was 3.0±0.69, ranged from 1.18 to 3.68 and 7.97±2.29,ranged from 5.50 to 13.0 in group I (diabetic neuropathy) and group II (diabetic without neuropathy) respectively. The mean PI difference was found statistically significant (p<0.05) between group I (diabetic neuropathy) and group II (diabetic without neuropathy).

Conclusion: In this study it was observed that Pulsatility Index (PI) decreased and Ankle Brachial Index (ABI) increased in diabetic neuropathic group. There was significant difference of Pulsatility Index (PI) and Ankle Brachial Index (ABI) found between diabetic subjects with and without neuropathy. So, from the finding of the present work, it can be said that diabetic neuropathy affect the arterial flow detected by non invasive duplex colour Doppler imaging may help in proper patient management and may prevent neuropathic arterial complications. But for any definine conclusion, bigger appropriate study should be done.

Key wards: Diabetic Neuropathy, Diabetes Mellitus.

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Introduction:

The chronic hyperglycaemia is associated with long term damage, dysfunction and failure of various organs, especially eyes, kidneys, nerves, heart and blood vessels[1]. Diabetic neuropathy is one of the most disabling chronic complications of diabetes mellitus (DM). Experience at BIEDEM showed that 60-70% of the diabetic patients with foot ulcers have neuropathy and 15-20% have neuropathy as well as vascular problem[2].The few studies of blood flow in peripheral neuropathy which have been under taken have shown a markedly increased resting flow with loss of the normally occurring spontaneous variations which depend on sympathetic activity[3]. Abnormal blood flow consistent with reduced peripheral vascular resistance is very common in the feet of diabetic patients with neuropathy. Often there is no evidence of peripheral arterial disease but the neuropathy may lead to disturbance in blood flow which may be important in the aetiology of the foot lesions. The diagnosis of extent and nature of blood flow abnormality in diabetic neuropathic foot is important in the evaluation and management of diabetic patients. Intra arterial digital subtraction angiography has been considered the gold standard in diagnostic imaging for the evaluation of peripheral arteries but it is invasive and expensive[4].

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Ultrasound is now both competitive and complementary to angiography for many arterial investigations even when the circulation is seriously compromised . Doppler ultrasound is a relatively inexpensive, non invasive imaging technique. The study was designed to find out the difference between pulsatility index (PI) and ankle brachial index (ABI) in diabetic subjects with and without neuropathy by using duplex colour Doppler It will be beneficial for the diabetic patients.

No such study was done with Bangladeshi diabetic population.

Materials and methods:

This cross sectional study was performed on diabetic subjects in the Department of Radiology and Imaging, BIRDEM from July 2008 to May 2009, who were referred from neurology and preventive foot care OPD, BIRDEM, for colour Doppler imaging of lower limb arteries total 88 consecutive diabetic patients age ranged from 27 to 57 years were included in this study. Out of them 48 were diagnosed cases of diabetic neuropathy and 40 were diabetic without neuropathy (Neuropathy was diagnosed and evaluated by consultant neurologist of BIRDEM). Demographic information was prospectively recorded and substantiated by means of inspection of medical records. Information included the subject's age, sex, medical and surgical history, clinical history of diabetic neuropathy, followed by colour Doppler study with spectral analysis. A Siemens sonoline machine with a 7.5 MH_Z linear phase transducer was used.

Selection of the patients :

Inclusion criteria

- Diagnosed diabetic patient with and without neuropathy.

Exclusion criteria

- Amputation of part of one lower limb
- Significantly debilitated patients

Sample size:

Total 88 consecutive diabetic patients age ranged from 27 to 57 years were included in this study. Out of them 48 were diagnosed cases of diabetic neuropathy (Group I) and 40 were diabetic without neuropathy (Group II).

Subject preparation:

The objective of the study was discussed in details with the patients before their decision to enroll themselves into the study. Written informed consent was taken from each subject. Demographic information was prospectively recorded and substantiated by means of inspection of medical records. Information included the subject's age, sex, medical and surgical history, clinical history of diabetic neuropathy, followed by colour Doppler study with spectral analysis.

The colour Doppler study was performed first by the investigator herself and subsequently confirmed by a radiologist of the Department of Radiology and Imaging, BIRDEM, separately to eliminate bias. Ankle Brachial Index (ABI) and Pulsatility Index (PI) were recorded on both left and right lower limbs.

Choice of ultrasound machine and transducer:

Siemens Sonoline antares and Medisones Sono Ace 8000 Live

7.5 Megahertz linear phase transducer

Data collection and measurement:

Before colour Doppler Ultrasound examination, proper counseling and reassurance to the patient regarding the examination procedure was done to reduce their apprehension and to get full co-operation. A siemens sonoline machine with a 7.5 MH_Z linear phase transducer was used. Each subject was placed supine. Gray scale imaging was performed first to obtain an overview anatomy of the limb. The Ankle Brachial Index was evaluated in the supine position, after a 5 minutes rest. A standard 12 cm sphygmomanometer cuff was placed on each arm (standard position) and just above the ankle and a Duplex colour Doppler ultrasonic instrument was used to detect each pulse. The cuff was inflated to 10mm of Hg above systolic pressure and deflated at 2mm of Hg/sec, the first reappearance of the pulse was taken as the systolic pressure. The systolic pressure was taken a second time and two values were averaged. If any pair of the value differed by more than 6mm of Hg, repeat pressure was taken and the average of the most consistent pair was used for subsequent analysis. Value of ABI e"1.3 was considered significant. The pulsatility index was recorded from posterior tibial and dorsalis pedies arteries by the built-in software.

Statistical analysis of data:

Statistical analysis of the results were done by computer software device as statistical packages for social scientist (SPSS). The results were presented in tables,

figures, diagrams etc. For significant of differences unpaired 't' test and 'p' value <0.05 was considered as significant.

Results:

This study was carried out in 88 subjects. Out of them, 48 were diagnosed cases of diabetic neuropathy and 40 were diabetic without neuropathy. They were divided into male and female groups. Out of which 25 were male and rest 23 were female patients in group I. In group II 25 were male and rest 15 were female patients.

Table-I

Ankle brachial index (ABI) of the study subjects in group I (Diabetic Neuropathy) and group II (Diabetic without neuropathy) (n=88)

	Group I Mean± SD (Range)	Group II Mean± SD (Range)	P value
ABI	1.44 ± 0.07 (1.3-1.59)	1.17 ± 0.06 (1.05 - 1.26)	0.001[S]

* S= significant ,* P value reached from unpaired 't' test

The mean ABI was 1.44 with standard deviation of mean (SD) ±0.07 and their ranged from 1.30 to 1.59 in group I. In group II the mean ABI was 1.17 with standard deviation of mean (SD) ±0.06 and their ranged from 1.05 to 1.26. The mean ABI was statistically significant (p<0.05) between group I and group II in unpaired t-test (Table I).

Table-II

Pulsatility index (PI) of the study subjects in group I (Diabetic Neuropathy) and group II (Diabetic without neuropathy) (n=88)

	Group I Mean± SD (Range)	Group II Mean± SD (Range)	P value
PI	3.0 ± 0.69 (1.18 - 3.68)	7.97 ± 2.29 (5.5 - 13)	0.001[S]

*S= significant ,*P value reached from unpaired 't' test

The mean PI was 3.0 with standard deviation of mean (SD) ±0.69 and their ranged from 1.18 to 3.68 in group I. In group II the mean PI was 7.97 with standard deviation of mean (SD) ±2.29 and their ranged from 5.50 to 13.0. The mean PI difference were found statistically significant (p<0.05) between group I and group II in unpaired t-test (Table II).

Discussion :

This cross sectional study was carried out with an objective to evaluate the usefulness of non-invasive duplex colour Doppler sonography of lower limb arteries with measurement of pulsatility index and Ankle brachial Index in patients of diabetic neuropathy and compare the findings with those of diabetic without neuropathy. Williams et al. (2005) mentioned several ABI values >1.3 were demonstrated in individuals without arterial disease[5]. World intellectual property organization (2007) mentioned in their web publication that there was an association between ABI values and neuropathy. Edmonds et al. (1983) have found the ankle brachial index significantly raised in the diabetic neuropathic subjects, which were 1.45±0.13 and 1.16±0.11 in diabetic neuropathic and diabetic without neuropathic respectively[6]. Takahashi et al. (1998) found mean ankle brachial index (ABI) was 1.11±0.15 in group A (diabetic neuropathy) and 1.08±0.17 in group B (diabetic without neuropathy),7 which are closely resemble with the present study, where the mean ABI of the current study was 1.44 ±0.07 and their ranged from 1.30 to 1.59 in group I (diabetic neuropathy). In group II (diabetic without neuropathy) the mean ABI was 1.17 ±0.06 and their ranged from 1.05 to 1.26.

Edmonds et al. (1982) showed increased diastolic flow indicated by a reduced pulsatility index of 2.88 ±0.8 compared with 9.53±4.0 (p <0.001). Archer et al. (1984) observed mean PI was 3.2±1.0 in the severe sensory neuropathy group and 17.1±9.5 in the diabetic control group, which is consistent with the present study, where the mean Pulsatility index (PI) of the present study was 3.0±0.69 and their ranged from 1.18 to 3.68 in group I (diabetic neuropathy). In group II (diabetic without neuropathy) the mean PI was 7.97 ±2.29 and their ranged from 5.50 to 13.0. The mean PI difference were found statistically significant (p<0.05) between group I (diabetic neuropathy) and group II (diabetic without neuropathy). From the result of the present study, it

was conceived that none of the diabetic without neuropathy subjects displayed PI value d"5, ABI value e"1.3, PI value lesser than this value and ABI value higher then this value favoured the diagnosis of a diabetic neuropathy having abnormal blood flow in the foot.

It thus could be concluded that colour Doppler imaging (CDI) along with measurement of pulsatility index and Ankle brachial index is one of the accurate diagnostic imaging tool for monitoring the predictive power in identifying those at greater risk of developing and progressing vascular foot problem due to diabetic neuropathy.

Conclusion:

In this study it was observed that Pulsatility Index (PI) decreased and Ankle Brachial Index (ABI) increased in diabetic neuropathic group. There was significant difference of Pulsatility Index (PI) and Ankle Brachial Index (ABI) found between diabetic subjects with and without neuropathy. So, from the finding of the present work it can be said that diabetic neuropathy affect the arterial flow which can be detected by non invasive duplex colour Doppler imaging may help in proper patient management thus prevent neuropathic arterial complications. But bigger appropriate sample size should be studied for any conclusion.

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